ENGINEERING NEWS

A JOURNAL OF CIVIL, MECHANICAL, MINING AND ELECTRICAL ENGINEERING

Vol. LI. No. 4. New York, January 28, 1904.

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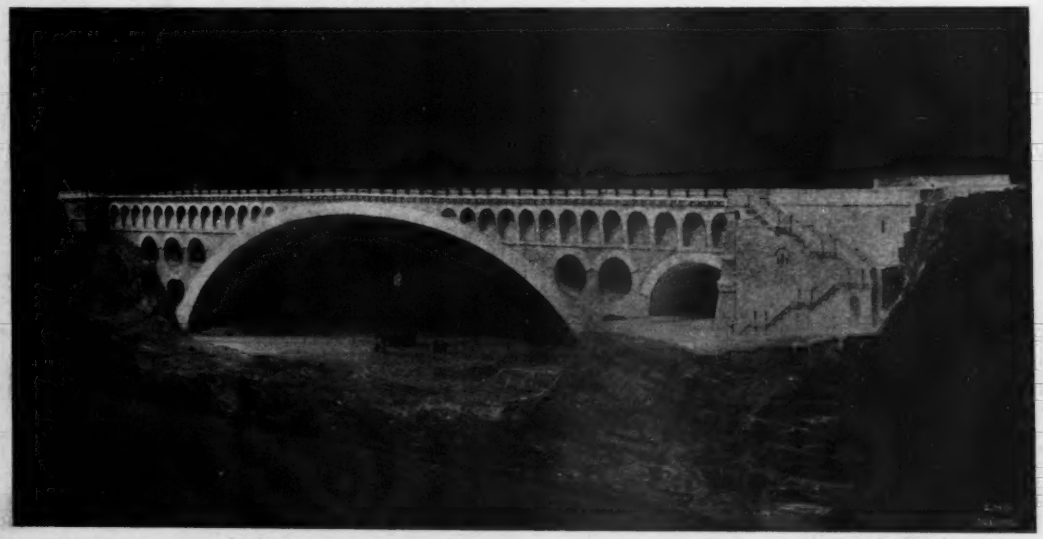
THE NEW STONE ARCH BRIDGE OF 295 FT. SPAN AT PLAUEN, SAXONY.

A stone arch bridge with a clear span of 295 ft. is now in process of construction at Plauen, in Saxony. The span of the new bridge is 75 ft. greater than that of the Cabin John arch, and is greater by about 18 ft. than that of the recently completed Luxemburg Bridge. The Plauen viaduct will, therefore, be the longest stone arch ever constructed. Stated exactly, the new bridge has a span of 90 m. (295.2 ft.). It is constructed of stone masonry throughout, and the contract price is surprisingly low, it being only 500,000 marks, or in round figures $120,000. This very moderate cost is explained by the low cost of manual labor in Saxony and by availability close to the bridge site of excellent stone for masonry. The designer of the bridge was Mr. C. Liebold, of the firm of Liebold & Co., of Langebrück, Saxony, which has the contract for the work.



MODEL OF 295.2-FT. SPAN STONE ARCH BRIDGE UNDER CONSTRUCTION AT PLAUEN, SAXONY.

GENERAL DESCRIPTION.— The drawings of Fig. 1 show an elevation and several sections of the Plauen Viaduct. It has a total length of 150 m. (492 ft.), and is 17 m. (55.76 ft.) wide over all. As in the Luxemburg Bridge, the main arch springs from the bottoms of the foundations, and its full span is, therefore, concealed by the overlying earth. It will be noted also that the lower portion of the arch at each end is bonded into the abutment masonry in such a manner that a sort of balanced pier is formed at each end. Between these piers the span of the arch ring is 65 m. (213.2 ft.), with a rise of 6.5 m. (21.2 ft.). The soffit of the arch is a five-centered curve with radii of 105 m., 58.5 m. and 30.1 m. (344.4 ft., 191.8 ft. and 101.7 ft.). At the crown the arch ring is 1.5 m. (4.92 ft.) thick.

The balanced piers, arch footings, or masonry spandrels, as one may choose to designate them, are pierced transversely by arched openings to lighten them, and on one side there is in addition a large opening of 14 m. (45.9 ft.) span for the passage of a street railway. Over the center portion of the arch the weight of the filling is reduced by a cellular construction of masonry walls roofed over with arches. There are six of these arched vaults on each side of the crown, and they reduce the depth of the fill to 1.5 m. (4.92 ft.) for a length of about 220 ft. The fill at the ends over the arch footings is from 5 m. to 6 m. (16.4 to 19.68 ft.) deep, and this is therefore the greatest height of the spandrel walls. These walls are solid and have a batter on both sides, with projecting piers and arches on the face to carry the sidewalks and to form an architectural facade. The details of the construction are plainly shown by the drawings. Between facades the bridge is 16 m. (52.5 ft.) wide. The facade arches have a span of 1.5 m. (4.92 ft.) each. All portions of the masonry against which the earth fill comes is waterproofed with felt laid in tar. The usual drain pipes at low points are also provided.

The bridge will be used for street traffic, with a street railway and gas and water mains. The roadway is 11 m. (36.1 ft.) wide and the sidewalks are each 3 m. (9.88 ft.) wide. The construction of the arch required from 10,000 to 12,000 cu. m. of stone and 12,000 barrels of cement. The total load on the foundations will be 15,000 tons and the pressure on the foundation beds will be 24 kgs. per sq. cm. (341 lbs. per sq. in.).

CONSTRUCTION. — The preparation of the foundations for the arch called for very little work. An excavation of from 4 to 6 ft. was sufficient to remove the poor surface rock. Seams and old mining shafts and tunnels were filled with cement. The rock was then cut into a series of rough steps as shown by Fig. 1, which also shows the direction of the stratification.

The arch foundations being prepared, the next step was to construct the arch centers. To support these a series of five parallel trenches were excavated across the bridge site and filled with reinforced concrete as indicated in the view Fig. 2. The centers themselves were built of spruce timber, and their construction is shown by Figs. 3, 4 and 5. About 2,000 cu. m. of timber were required for their construction. The centers were built in three stages, as shown by the illustrations, and their construction was greatly facilitated by the high banks at each end. Manual labor was employed exclusively in erecting the centers, and about three months was required to get out the timber and to erect it. Forty men were employed in this work. The erection proper took six weeks. As will be seen from Fig. 5, a service bridge was carried over the arch center. It will also be noted from this illustration that vertical forms were erected for the arch ring face. After the completion of the arch center, the first task was to cover the top of the lagging and the inside faces of the vertical forms with cement. Strips of molding were attached to the vertical forms and for a short length inward on the soffit lagging to mark this plastering to imitate cut stone. The arch ring masonry was laid up to these prepared faces with mortar joints. The ring was built of voussoirs alternately two stones and three stones deep. The arch ring was built in six sections, separated by transverse openings filled temporarily with timber struts and keyed in from the crown downward after the other ring masonry was completed. These key spaces were from 1 m. to 2½ m. (3.22 ft. to 8.2 ft.) in width.

The stone used for the arch ring was schist, hav-

ing a crushing strength of 1,830 kgs. per sq. cm. (26,000 lbs. per sq. in.). The thickness of the arch ring stone, and of that used for facing the haunches, varied from 10 cm. to 12 cm. (3.9 to 4.7 ins.). All masonry was laid in Portland cement mortar. The arch ring was completed on Nov. 20, 1903, and work was stopped until the coming spring. It is expected to strike the centers in April, 1904, and to have the bridge completed by the following August. The deflection of the centers under the arch masonry was 2.5 cm. (about 1 in.). A view of the completed bridge is of course not yet available, but the accompanying engraving from a photograph of the model will give a fair idea of its appearance. For the information from which this description has been prepared we are indebted to Mr. Charles R. King, of Dresden, Saxony.

ANNUAL MEETING OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

An attendance of unusual magnitude signalized the annual meeting of the American Society of Civil Engineers, held last week in New York city. It was plain that the members had been attracted by the prospect of an animated discussion of the question whether or not the society should coöperate in accepting the million-dollar gift proffered by Mr. Andrew Carnegie for a new union engineering building to house the four national societies of civil, mechanical, mining and electrical engineers. As matters turned out, however, the discussion was less active than it had been at the Annual Convention at Asheville, N. C., last summer. Not more than a half-dozen different members took the floor for and against the proposition, and with one or two exceptions these were not men who had been in the past prominently identified with the controversy. It was in the corridors and lunch rooms during the intervals before and after the session that the question was most thoroughly discussed by the members in general. In the meeting the prevailing disposition seemed to be to submit the matter without further contention to the final decision by a letter ballot. Some few enthusiastic partisans only took occasion to register their views for or against the proposition, and no positive attempt was made to obstruct the passage of the resolution calling for a letter ballot to decide the question, and this was finally passed by a large majority vote.

The business meeting was held in the Carnegie Lyceum, about a block away from the Society House in 57th St. The President, Mr. Alfred Noble, occupied the chair, and called the meeting to order at 10 a. m., Jan. 20. The first real business of the session was the presentation of the Report of the Board of Direction, and those of the Secretary and the Treasurer of the society.

REPORT OF BOARD OF DIRECTION.—During the calendar year 1903 a net addition of 212 was made to the membership of the society, bringing its total membership on Dec. 31, 1903, to 2,924. The total number of members added by election during the year was 290, and this number, less the 147 members lost through death and other causes, gives the 212 net increase noted before. During the year 35 members were lost by death, among them being Alphonse Fteley, Prof. E. A. Fuertes, George S. Morison, Elnathan Sweet and Prof. R. H. Thurston. The accessions to the library during the year numbered 3,950, making the total number of titles in the library 19,853 at the present time. The receipts during the year were $65,637.73, and the disbursements, including $3,000 appropriated for an engineering exhibit at the Louisville Purchase Exposition, and $10,000 paid on the mortgage against the society house, were $65,044.58. The cash on hand on Dec. 31, 1902, was $26,297.39, and on Dec. 31, 1903, was $26,890.54. The following is the general balance sheet of the society's finances:

Assets.		
Building and lot (cost)		$191,730.26
Furniture (cost)		16,232.64
Publications on hand (inventoried cost value)		14,401.85
Library:		
Cash expended for books, etc.	$8,721.36	
Estimated value of donations	42,721.84	
		51,443.20
Due from members	$2,373.96	
Due from non-members	905.17	
		3,279.13
Cash		26,890.54
		$303,977.62
Liabilities.		
Dues for 1904, paid in advance		$13,281.11
Mortgage debt		55,000.00
Funds invested in society house and lot and library		235,696.51
		$303,977.62

The report concluded with the following general remarks:

> In concluding the report, the board is glad to be able to summarize the general condition of the society as satisfactory in every way. Notwithstanding the payment of $10,000 of the mortgage indebtedness, and the appropriation and payment of $3,000 to a special committee for the establishment of an engineering headquarters and an engineering exhibit by the society at the St. Louis Exposition, the balance on hand is somewhat larger than that of last year. In addition to this, the board has felt justified, after the other national engineering societies had declined to co-operate in the project, in assuming the entire responsibility for the expense of holding an international engineering congress, in connection with the exposition. This congress will be held during the week beginning October 3, 1904, and the visit of members of the Institution of Civil Engineers, which has been arranged for, will be so timed that, after a brief stay in New York as the guests of the society, all who so desire will be able to attend. It is hoped that all members of the society will aid the committee which has been appointed by the board to organize and conduct this congress.
>
> The board has devoted much time to the effort to carry out the instructions of the Asheville convention, as to the preparation of the project for a union engineering building for presentation to the society. Everything possible has been done to place the project on such a basis that all members may have an opportunity to vote upon it, and the result will be placed before this annual meeting, together with arguments for and against participation by the society. The board makes no recommendation in this matter, believing that the society at large should decide what is probably the most important question which it has yet been called upon to determine.

The report of the Board of Direction was received and ordered placed on file without comment. Announcement was then made by the Secretary that the awards of the various medals and prizes had been made as follows: The Thomas Fitch Rowland prize to Mr. Geo. W. Fuller for his paper on "The Filtration Works of the East Jersey Water Company, at Little Falls, New Jersey," and the Collingwood prize for Junior Members to Mr. Isaac Harby, for his paper on "The Footbridge for Building the Cables of the New East River Bridge." No award was made of the Norman medal.

The reports of special committees were then called for and a brief progress report was made by the Committee on Uniform Tests for Cement, which was received and placed on file. A resolution was then presented requesting that the proposition to appoint a committee to coöperate with a committee of the American Society for Testing Materials, and a committee of the Railway Engineering and Maintenance of Way Association in devising standard methods for testing concrete-steel should be submitted to letter ballot. The resolution was passed by a very large majority vote.

UNION ENGINEERING BUILDING.—The next item of business was the presentation of the "Report of the Board of Direction in the Matter of the Proposed Union Engineering Building." This report was printed in full in Engineering News of Jan. 21. It was carefully read by the Secretary and the reading was followed with close attention by the members. In presenting the report to the meeting for consideration the President, Mr. Alfred Noble, made the following announcement:

> This action is concurred in on the part of all the mem-

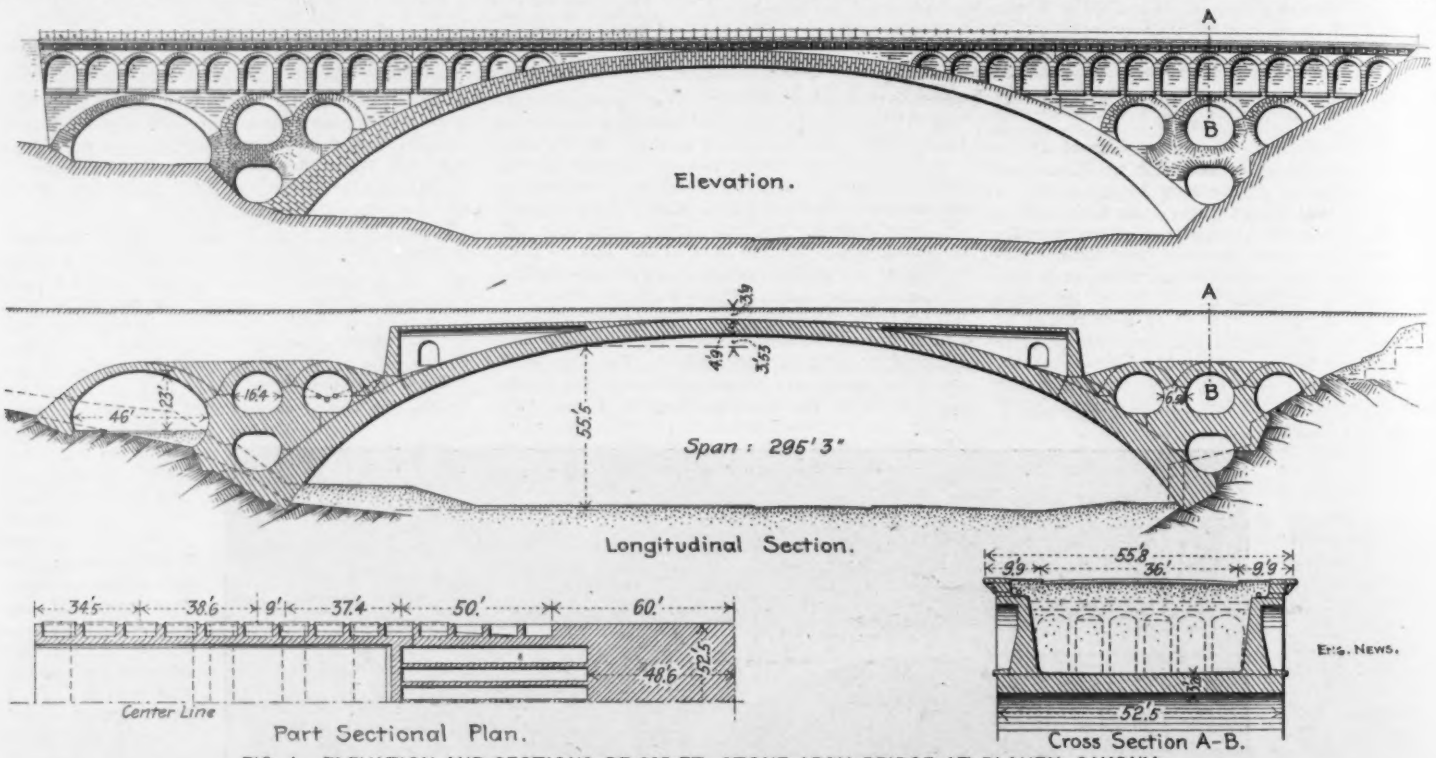


FIG. 1. ELEVATION AND SECTIONS OF 295-FT. STONE ARCH BRIDGE AT PLAUEN, SAXONY.
Liebold & Co., of Langebruck, Saxony, Engineers and Contractors.

bers of the Board of Direction whom it has been possible to consult with. The joint conference committee is composed of representatives of the five organizations named in Mr. Carnegie's offer. An interview was had with Mr. Carnegie at his residence on the evening of Jan. 18, 1904. It was attended on the part of the organizations by one representative from each, the American Society of Civil Engineers having been represented by me. It was represented to Mr. Carnegie that the preliminary plans of the proposed building, based on the estimates of space required as submitted by the several organizations, showed that the amount named by him in his original letter, $1,000,000, would not be adequate for the purpose intended and the approximate estimates of cost of a suitable building were submitted, whereupon he added the following words to his original offer:

Jan. 18, 1904.

Your plans for the allowed space show a greater sum is needed. I make it $1,500,000.

Signed, Andrew Carnegie.

Early in the conference Mr. Carnegie showed great interest and anxiety as to the probable action of this society, expressing the idea, that in readiness to co-operate, Americans excel all other nationalities and hence their work is more effective, and hoped that this society would decide to co-operate by a great majority.

To a suggestion that the project should be proceeded with vigorously he demurred, saying it would be necessary to ascertain first whether the American Society of Civil Engineers would accept and by repeated references made it clear to all present that he anticipated the acceptance by all the organizations to make the offer effective. Among other expressions, one was particularly pointed; that if this society should decline to come into the project, he would have on his hands the five lots purchased for the union engineering building, but he did not consider this investment a serious matter. The conference was reported in some detail, because it indicates an important difference in the status of the project from that hitherto supposed by the board of direction, on which a statement has been predicated. The board has had ample reason to believe that Mr. Carnegie would provide for the other societies, if this society decided that its best interest required it not to join. It is not doubted that such was Mr. Carnegie's idea at one time. Now, however, it is clear that his offer is to be taken exactly as written to all of the organizations, these organizations being the four national engineering societies and the Engineers' Club.

The discussion was opened by Prof. Palmer C. Ricketts, who made a motion that the recommendations of the Board of Direction that the proposition be submitted to letter ballot be adopted, and that with the ballots a statement be sent that it was the opinion of the majority of the members present at the annual meeting that the society should decline to coöperate in the proposed union building project. Professor Ricketts' motion was followed by a motion made by Mr. F. S. Curtis that instead of a majority vote by letter ballot, a two-thirds vote be required to commit the society to co-operation. Mr. E. W. Stern moved that there be issued with the resolution recommending the ballot, by the Board of Direction, a statement of the conditions required for membership in the societies of mechanical, electrical and mining engineers and the Engineers' Club; also a statement of their present financial condition.

The clearing away of these several motions resulted in some heated discussion and much confusion. The discussion related partly to the wisdom of encumbering the original resolution with any of the qualifications or addenda that had been suggested and partly to the main question at issue, which was the advisability of accepting or declining the proposal to coöperate in Mr. Carnegie's gift. It was finally decided to pass the resolution of the Board of Direction in its original form, the motions of Professor Ricketts and Mr. Curtis being withdrawn by their authors and that of Mr. Stern being voted down.

The discussion relating strictly to the advisability of coöperating in the gift of Mr. Carnegie was opened by a letter from Mr. William D. Pickett, whose membership dates from July 6, 1853. Mr. Pickett's letter was as follows:

As the decision of the society will probably be made at this approaching annual meeting, on the 20th of January, as to its acceptance or not of the proposition of that great philanthropist, Mr. Andrew Carnegie, I desire briefly to express my views.

Mr. Carnegie stands ready to donate $1,500,000 for the erection of a suitable building in New York city for the joint headquarters of the American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Mining Engineers, American Institute of Electrical Engineers, and the Engineers' Club, a purely social club.

I am decidedly opposed to the acceptance of this offer by the American Society of Civil Engineers for the following considerations:

From its inception, something over 50 years ago, by a few civil engineers residing in and around New York city (Julius W. Adams, Alfred W. Creighton, James Kirkwood and others) the society has increased from a membership of 50 to a membership of nearly 3,000 at the present time. Its membership embraces practically all the leading civil engineers of this country. Its professional papers, issued monthly, compare favorably with those of any civil engineers' society. It is the leading society of engineers of the western hemisphere as the British is of the eastern hemisphere, although its progress has been nominally much more rapid than either the British Institute or the leading French society, for a similar length of time. Its progress was retarded about 2½ years at the advent of the bloody conflict between the states from 1861 to 1865. The smoke of that conflict had not more than cleared away, when the members of our society residing in and around New York city, took steps to gather together the remnants of the society. On Oct. 2, 1867, the society was reorganized and the old members in either section of the country were notified. Since that date it is growing in membership. It has increased to nearly 3,000 at the present time, a membership which is not exceeded by any similar society in the world. Judging by the number of monthly applications for membership, in a few years the number will increase to 5,000 names, if the society desires. Its income will increase proportionately. At present it is sufficient for the monthly publication of the papers, that means benefit to non-resident members, especially to younger members, and causes them to take a personal interest and add to the society. A member, who, as the writer, may have visited the society at 73 William St., as late as 1875, and compared it with the modern location of our society, 220 West 57th St., is apt to state that the society as yet needs no more suitable quarters.

For the reasons outlined above I earnestly hope the offer of Mr. Carnegie, covered, as it is, with a kind of partnership with other societies—however worthy their object—will not be accepted.

The American Society of Civil Engineers should by all means have a separate building. In 10 or 15 years a very large building may be needed for library room and its other wants. At present it seems to me we need no more commodious quarters. By the time such quarters are needed, a way will be pointed out to obtain them. I am sure Mr. Carnegie will appreciate our reason for declining his offer, should that be the decision, and it may be he will agree to divide the donation. Should the amount be sufficient for greatly enlarged quarters, it should be accepted.

Mr. Carnegie has set such a pace for the men of great wealth by liberal donations to works of charity and education, that should he not respond to the last suggestion, there will be found others who would consider a donation of such amount and with such conditions as would be acceptable to the society.

I have been a member of the society for more than 50 years and am classed among the charter members, and with Mr. Thomas C. Meyer, am the surviving member of that class. It has been my misfortune to be engaged in life so far from headquarters as to have attended only a few of the annual conventions or to participate in the benefits of the society except through its publications. I have always taken a deep interest in its welfare and have been the means of getting a good many new members. Now, in the decline of life I feel a deeper interest than ever and hope my views as given above will be the views of the society. I am sure that could the founders of the society be consulted, they would coincide with my views.

Very truly, Geo. D. Pickett.

Mr. John F. O'Rourke.—Sometimes arguments are made morally and sometimes physically. Some of the latter are very unpleasant. I have met some of them and got away from them. An argument in favor of a new society house is being presented by the occupants of this room, by an audience sufficiently large to fill it, in the shape of loud cries from the rear of "louder." That is the annual meeting of the American Society held in 1904, a society whose commodious quarters are not sufficiently commodious to take it in. This American Society of Civil Engineers, under its constitution, can receive as members the members of all the other bodies that have been addressed by Mr. Carnegie in his letter, and there are three or four more, that the constitution does not allow, who are eligible for membership. If we carried out the original idea of the society, and I think we are doing it as far as we can and that we will continue doing it, we would have a place where all of them could come and where all of them would have room, whether Mr. Carnegie or the gentlemen themselves furnished the necessary funds to provide the house or to provide the land. This society would then meet with all engineers who are civil engineers, whether they are compelled by circumstances to join the smaller subdivisions of that body or not. The question that we have before us to-day is not altogether a question whether we are going to hold ourselves as good as we are, of whether we are not going to be swallowed up by one of our smaller subdivisions, who really belong to ourselves and whose honor is our honor, because we happen to be in the same building with them. Every argument made against this motion, as presented in the report of the Board of Direction, is as strong and decided a piece of pessimism as anybody can find. If this society is going to follow in the general line of American progress it will get on the path of optimism. It started optimistic. Its first meeting in William St. and its first society house in William St., was not the meeting or the society house of a lot of pessimists. The society house that is proposed in 39th St. is not a society house of pessimists. Mr. Carnegie is not a pessimist. We

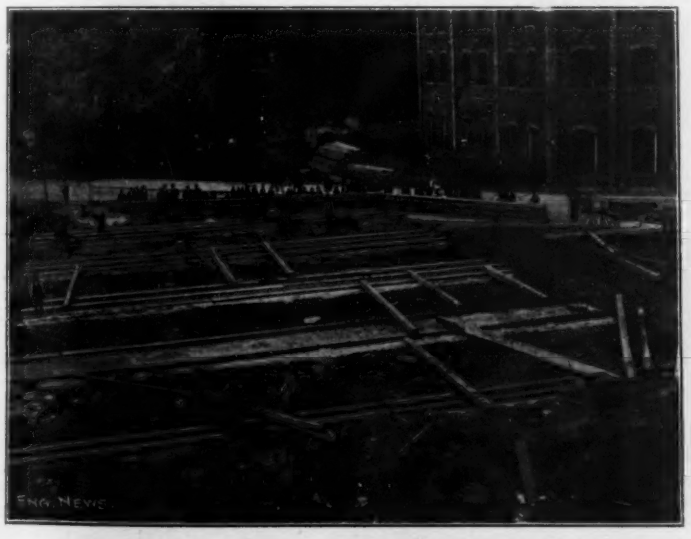


FIG. 2. VIEW SHOWING CONCRETE FOOTINGS FOR 295-FT. ARCH CENTER.

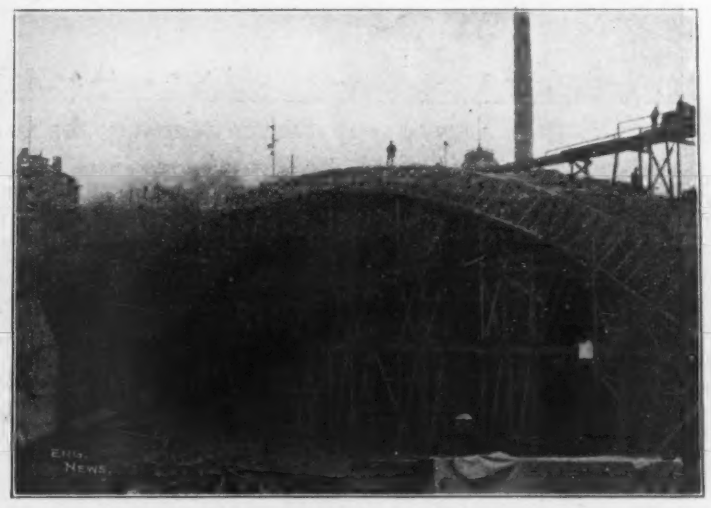


FIG. 5. VIEW OF ARCH CENTER WITH ARCH RING MASONRY COMPLETED.

debated amalgamation in the society long ago. It was always favored and always voted down, and what are we doing now? We are still debating that same thing, some of us favoring it, some of us to the extent of $1,500,000, and there is already a motion before the house that a notice that it should be voted down should be sent out. I believe, Mr. Chairman, that if we have a society house in which American civil engineers would go, mechanical, civil or electrical, or whatever they are called, so long as they are engineers and ARE engineers, that the engineering body would be strengthened. I believe we are all engineers and brothers, and believe in this project to make brothers live in one house commodious enough for all. The value of that house will provide four or five times as large a one where we can get away from these high buildings and from the social club that is so awful if it ever becomes desirable. By the way, I understand you have to get into that social club with a jimmy, from all I can read. We are going to have a lot of arguments and we are going to have men here sit down on this proposition because they love this society so much. I say that the stronger and better we are ourselves here, the stronger and better we will appear when we are viewed in connection with those we do not believe as good. I believe in them all. I do not think we would be a great engineering society if we did not, and I do believe we ought to follow in the path of progress.

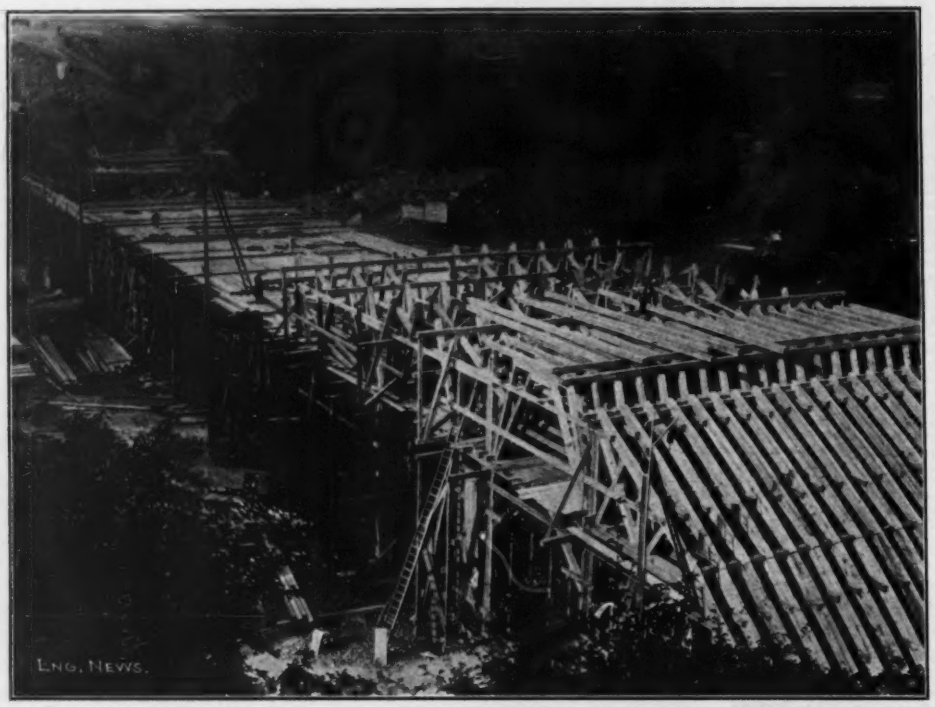


FIG. 3. VIEW OF FIRST STAGE OF FALSEWORK FOR 295-FT. ARCH.

Mr. E. E. Olcott.—It is very interesting, this report that has been read, but it lays entirely too much stress and weight on the management of the society. This society would be just the same as always, and it will go ahead and publish the most valuable papers on civil engineering. It is only a question of tenancy that is coming up before us. It does not seem to me that it would hurt the society or the standing of the society. It is only whether we shall accept the present of $1,500,000, or our proportionate part of that, and it is only whether we shall be in the front ranks of progress and coöperation. Now scientific men in the United States stand for coöperation, and it is one of the greatest glories of our country. It is no rivalry, our giving to the world the results of our investigations, and we must acknowledge that, as greatly as this society has increased in membership, the brilliant, the stirring, the phenomenal things that have been done in engineering, have not all been done by this society, and possibly in the last few years the other societies have eclipsed us in astonishing the world by scientific works. I think that this society, in the interest of the civil engineers, would be committing a great error to decline this offer, which I think only strengthens the society and in no way weakens it or lessens its individuality.

Mr. Samuel Whinery.—In the first place there seems to be a general mistaken idea as to what this whole measure involves. It has been stated distinctly that it does not involve a merger of the societies, nor a merger of their finances, but it seems necessary to go farther and inquire what it does mean. As I understand the whole proposition, and I do not wish to be understood here as speaking in favor of the measure or against it at the present time, but merely this particular point, that is involved—as I understand it, is this: It is proposed that the societies jointly invest in a certain tract of land for the purpose of erecting a building thereon for the joint occupation of the several societies. It is not proposed that the investment in that land shall be a partnership affair at all. It is to be held by a separate corporation, separate and distinct entirely from any of the societies and from all of them. That corporation is to be made up from representatives from each of these bodies. Now, this corporation will ask each society to purchase and be responsible for a certain amount of bonds, or its share of bonds, to be issued for this property; just the land for it, on which the building is to be erected. This society purchases and holds one-fourth or one-fifth, whatever it may be, of the amount of bonds issued to pay for that property and will have those bonds as property, and should they become worthless we lose the amount. That is all there is in that. Each society is asked to go into this building which it is proposed to erect without any cost to the society and to pay its share of the operating expenses of the building, nothing more. This corporation that it is proposed to have to hold this property and administer it, can assess certain rentals, certain expenses of management of the building against each society. They can do nothing further than that. I see no merger in that whatever. I do not see any partnership in it, and I do not see even any entrance of this society as a society into a corporation in which it is directly a member. I think it is important that the responsibility that this society shall actually assume be carefully separated from the burden which it seems to be the impression here the society is to assume. We do not assume responsibilities for this vast enterprise. We assume responsibility for only certain things in it. Now I do not see under these circumstances what benefit it would be to this society whatever to know the exact financial status of each sister society or what its standing for membership is to be. We are not uniting with them. The management of this society, if this measure is adopted, will be just as independent of any of the other societies as it is to-day, absolutely. The other societies obtain no rights in the management of this society by this proposed donation, and this society obtains no rights in the management of the other societies. Now, where are we interested in this matter of the financial standing of these societies or their standing in membership. If it was merely a question whether we should jointly occupy that building with a law firm I could see no objection to it whatever. I do not think the fact that this society, together with a law firm, or a medical association, or a single doctor, may agree together for their mutual benefit to rent a society house and use it jointly would in any way disparage this society. It is merely a question of the joint occupation for the common benefit of all, and it seems to me that we are going entirely too far, entirely further than is necessary, and certainly further than is courteous for this society to undertake, to inquire into the standard of membership or financial condition of its sister societies.

Mr. Edward P. North.—I referred this matter to a lawyer and he said: "In buying this land, will you become tenants in common? If you do, why then any part can be sold out. Or will you be joint tenants? If you are joint tenants, then in case of the failure of any tenant or part of the amalgamation you succeed to their holdings and rights in the amalgamation." I told him I did not know, and did not understand before that there was any difference between a joint tenant and a common tenant.

If we are joint holders in this affair, any constituent may, on the other's failure, succeed to his rights, but if we are tenants in common under this act then that part may be sold out, and we undoubtedly would be able to buy it. But we would have to bid in the common market for it. We find that there is no provision for cutting out any delinquent society. If a society becomes delinquent and we at that time are not able to buy their share, not only the society but a private individual might buy their share and take fully as great a control of the building, as I understand it, as we might. Under the execution I do not think that that would work. I am not a lawyer and I cannot say. My legal friend said to me: "This is a very important matter and you should get the very best legal advice that is possible." I asked, "Will that settle it?" Oh, no. What will settle it? He said, "The Court of last resort."

Now, gentlemen, we are asked by some of those here to make what you might call a polygamous marriage, and to make it under the rules of the Roman Catholic Church, that does not recognize divorce. When we make this it is made for life, and the only way we can get out of it is to get out of it and leave what we have, unless some law can be devised which will save us. I do not know whether that law can be devised or not, and my legal friend did not know whether it could or not, but he said we should get the very best legal advice possible.

I think that an engineer, and I believe everybody here present will agree with me perfectly and thoroughly, that an engineer who undertakes to do a piece of work before he has carefully looked not only to the possibilities of doing it, but the difficulties that he will meet, is taking money dishonestly. I think that all the difficulties in an enterprise of this kind should be fairly looked after and thoroughly met in the minds of the President and Directors of the Society.

The remarks of Mr. North completed the discussion, and after the usual introduction of the newly elected officers the session was adjourned.

The list of officers presented by the nominating committee was elected without opposition. It was as follows: President, Charles Hermany. Vice-Presidents, F. S. Curtis and S. L. F. Deyo; Treasurer, Joseph M. Knapp; members of Board of Direction, Charles S. Gowen, N. P. Lewis, John W. Ehis, George S. Webster, Ralph Modjeski, and C. D. Marx.

ECONOMY IN RAILWAY OPERATIONS.*

By W. B. Waggoner.†

Railways are the most expensively administered organizations in the world, aside from city governments. The real or actual cost that will completely cover any particular item of operation or manufacture, is an unknown element in railway accounting. Having had charge of the maintenance of equipment accounts of a large company for a number of years, an excellent opportunity was found during the hard times from 1893 to 1897 to study the subject of economies, as every item of expense was carefully examined with the idea of greater economies. The result showed most conclusively that something can be done along the line of more complete accounting and reduction of expenses. The ideas given in this paper are the result of that experience and a study of the subject from a broader point of view.

Railways are directly administered by men who have no personal interest in the question of economies and who have all they can do to keep things moving. One great reason why no personal interest is felt, is, that the official in charge has no financial interests at stake, and being on a salary, may be looking for another position to-morrow. A change of management nearly always makes more or less changes in minor officials, and often a complete one in heads of departments. It is not reasonable to expect men, under such circumstances to lie awake nights or work overtime, trying to save dollars. If one can make a record as an active man and a hustler he is doing all that he feels is necessary, both for himself and the company.

It takes all of an officer's time to keep things moving during periods of activity, and this is just the time that expenses get the upper hand of everybody. Officials rarely have the time or opportunity to study economies during periods of heavy business, even if they are anxiously inclined to do so.

The general situation as here outlined may be fully appreciated, and an operating officer see the thing to be done, and yet be helpless; so what is proposed is to give him assistance by establishing a co-operative bureau (not a department) to be known as the Bureau of Economies. This bureau must be general in its character, directly under the supervision of the general manager. It will be an office of record, and the head of the bureau will have no executive authority whatever. Here, in my opinion, lies the secret of the success or failure of such a bureau, which must be entirely co-operative and advisory in its conception, organization and administration. It must not interfere with the responsibilities or authority of any executive officer in charge of a department.

The organization should be as simple as possible—having for a large company: A head of the bureau, an assistant in charge of transportation economies, an assistant in charge of maintenance of equipment economies, an assistant in charge of maintenance of way supply economies, a chief clerk to co-operate with the three assistants. Standing committees should be organized with the superintendent of the department as chairman, the head of the bureau of economies, and the official next in line to the superintendent of department.

The head of the bureau should be constantly in touch with all operating details and operating officials—he should suggest to the heads of departments any points he may observe that could be investigated to an economical advantage, and particularly look for suggestions from such official heads. Where a general office is concerned in direct operation, as general superintendent or general superintendent of motive power, these officials should be ex-officio members of the committees advised of all that is being done and to act on the committees if they so desire.

The bureau should collect and keep a complete record of all operating statistics and expenses. In the case of special investigations, should furnish all clerical labor if necessary, and co-operate directly with the official in charge. The results are for the head of the department, and it is for him to decide upon the course to be followed in carrying out any recommendations of the committee. Only in this way can be preserved the dignity and responsibility of the operating official, and make the bureau something to be used and appreciated.

The head of the bureau should report directly to the general manager, who is thus fully advised of what has been done. The head of any department concerned in the report must therefore advise the general manager of the action taken, either that the recommendations have been acted upon, or reasons given for not acting. The general manager sees wide discrepancies in operating expenses on different divisions; the bureau can look into them and would find, probably, bad accounting in some cases, in others bad management.

On all railways, it is safe to say, there is more or less bad accounting. The auditors are usually satisfied if reports are on time and balanced up correctly, but whether care has been exercised in the distribution of labor and material to the proper expense accounts is a matter about which an auditor cannot know, unless some one from the accounting department is constantly in touch with the clerks in direct charge of the distributions.

The question of special accounting for the purpose of economies is one that railways could take up with great advantage. There is not a railway in the country that can tell the actual or complete cost of any particular operation, of train service, track department or shops. It is a case of estimates, guesses everywhere—more or less accurate, depending upon the intuition of the guesser. I once astonished our chief engineer by my rule for actual costs based on estimates, which was to get the estimate as carefully as possible and multiply by three. He was more than half inclined to agree with me, but said we could never get an appropriation on that basis.

A new general shop was built that was not to be attached to any particular division, and at my solicitation, the superintendent of motive power obtained from the general manager consent to put the shop on the basis of a private industry. As the plant exists for the production of work, charge everything about the plant to the work, and bill other shops for all the work done. The result was that the costs at this shop appeared to be from 40 to 60% greater than at any of the others. I say appeared, because in reality the cost was less—it was a case of accounting, as the other shops never were able to get at the true costs, and I had great difficulty in proving it to the master mechanics. A large number of items are made at railway shops that can be purchased cheaper outside, if their actual costs were known, but many master mechanics will say that flat cost and 10% is close enough to real cost, for the statement that the shops can make a thing cheaper than it can be bought. They forget that heat, light, power, handling materials, general labor, shop repairs, supervision, etc., are all legitimate parts of the cost per unit. A manufacturing plant that did not take these items into consideration in figuring cost would be bankrupt in a year.

Master mechanics, shop foremen and shop clerks need education along the line of more careful economical accounting, and this education can best come from such a place as our Bureau of Economies. Whatever work is being done, the fact of its cost is the first requirement in order that it may be directed to an economical product. A scientific method in accounts is as fundamental in educating men who are to have charge of work as any other part of the system of technical education, and this is now being recognized to some extent by technical schools.

The Bureau of Economies involves a close connection with all the producing elements, and its head and assistants should have such familiarity with the work as to be able to intelligently discuss any details involving questions of economy with the heads of departments. It may be questioned if a man strong enough for the head of such a bureau as we have described, would accept such a position, but I am positive that every railroad company has a number of men in its employ, who have all the qualifications for promotion to department heads, yet lack that most important one of executive ability. Such a man could well take charge of the bureau and make it a success, as he would be better able to investigate and co-operate, without interfering with administration. Whereas a man of good executive ability might be too much inclined to forget the co-operative spirit and do things which would antagonize the official heads of departments—all of which must be avoided if success is to be obtained.

Our bureau also could be of great help in the adjusting of labor questions. It would have records of the rates paid at various points, and when possible on other roads, would be familiar with the conditions at each shop or on each division; would have the time to thoroughly investigate complaints, and more than likely be able to convince the men, if the complaint is not a fair one, and thus settle the matter.

The time is rapidly approaching, in fact now is, when dividends will be a more important element in railway operations than has been the case. Earning fixed charges and operating expenses has been only necessary to keep the property out of the receiver's hands. There is no direction where net earnings can be augmented as easily as by the cutting down of wasteful and unnecessary expenditures, and a Bureau of Economies can be made a most helpful and efficient adjunct to the increasing of that last column of the statement, which the general manager always looks at first: "Net Earnings."

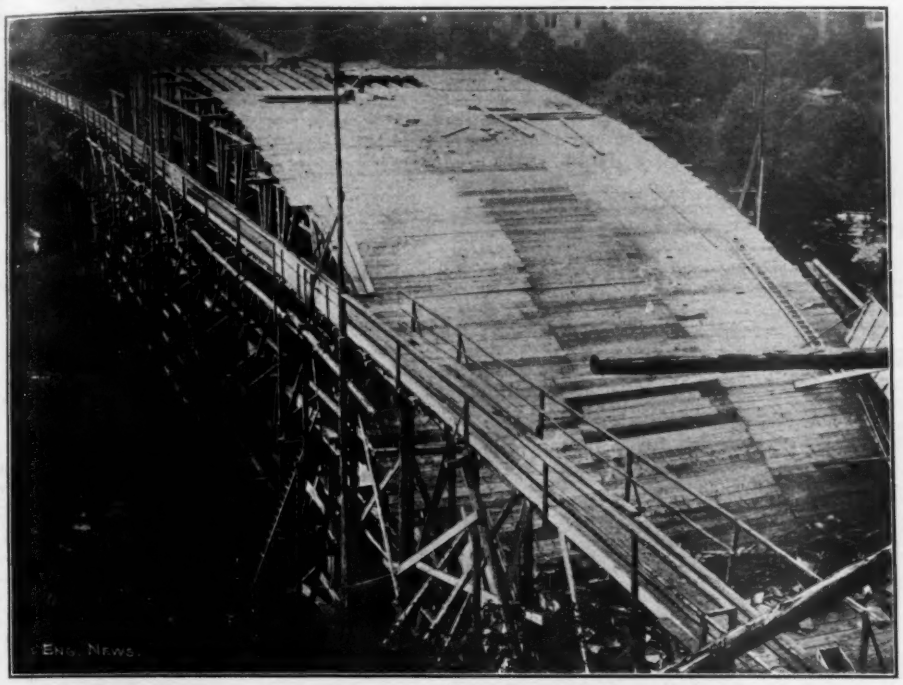


FIG. 4. VIEW OF ARCH CENTER, SHOWING LAGGING.

*Abstract of paper read at the meeting of the Western Railway Club, Chicago, Jan. 19.

†Butler Drawbar Attachment Co., Cleveland, O.

THE PREVENTION OF TYPHOID FEVER.

In an editorial article on "Prevention of Typhoid Fever," the New York "Medical Record" for Jan. 16 calls attention to the need of better organization of health departments in "the smaller cities and rural districts" and strongly urges that

> the cause of the prevalence of typhoid fever, either in its endemic or epidemic form, is not to be found in a contamination of the water, milk, or other food supply. These are usually the avenues along which the infective agent is conveyed. The cause lies back of this. It is none other than the failure to destroy the causative bacillus as, by various routes, it leaves the bodies of those suffering from the disease. Measures directed toward this end lie essentially outside the province of officials and come directly within the sphere of the medical practitioner.

After defending the great majority of the members of the medical profession against the accusation that they are culpable for failure to enforce proper means of disinfection, the article continues as follows:

> In looking for the routes by which the typhoid bacillus leaves the body we find that they are principally two: the fæces and the urine. The bacilli are most abundant in the fæces at the height of the disease. From this time on they become reduced in numbers. At the time when convalescence is reached they are usually absent. Exactly the reverse holds true for the presence of the bacilli in the urine. Here they usually first appear during defervescence. In convalescence they reach their greatest numbers. In many cases they are present in the urine for weeks after recovery. The disinfection of the fæces has received time-honored consideration. That it is efficiently carried out in the majority of cases of typhoid fever cannot be doubted. The disinfection of the urine is of more recent occurrence. Investigation will show that at the present time if the urine is disinfected at all this is only practiced during the disease or at the best only until convalescence is established. There is no doubt whatever but that in many instances those who have re-

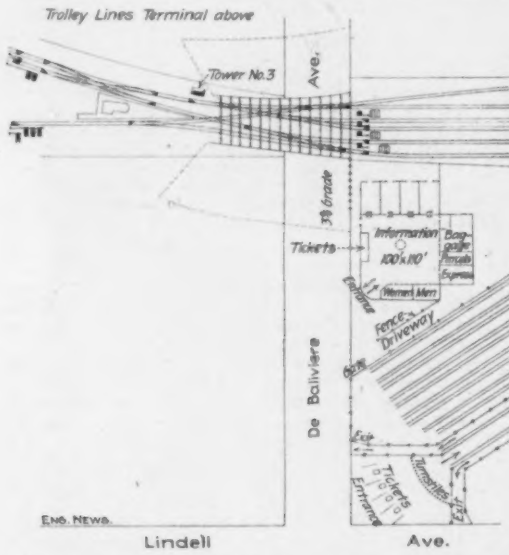
covered from typhoid fever go about voiding urine which contains typhoid bacilli and that this is by far the most frequent means of the dissemination of these organisms from these patients. The realization of this condition and the institution of the proper means for combating it by the medical profession is the crying necessity.

The prevention of typhoid fever at present, therefore, requires the consideration of two factors: (1) The destruction of the causative bacillus as, by various routes, it leaves the bodies of those suffering from the disease. (2) The safeguarding of the avenues of infection. The first and most important is to be accomplished by the physician. The second requires the attention of the authorities. Neither of these objects is to be accomplished by slander or incrimination. Education and organization are the watchwords.

NEW TERMINAL AND SIGNALING ARRANGEMENTS OF THE WABASH R. R. FOR WORLD'S FAIR TRAFFIC AT ST. LOUIS.

The Wabash R. R. has made plans for installing an interlocking and block signaling plant, for handling local traffic at the St. Louis Exhibition. For the plans and general particulars we are indebted to Mr. W. S. Newhall, M. Am. Soc C. E., Chief Engineer.

The map herewith shows the proposed terminal facilities at the World's Fair station. The two tracks for shuttle trains will be kept clear of other traffic as far east as Union Ave. (about 1,500 ft. east of the eastward limit of the map, Fig. 1), at which point they will converge with the other tracks into the double track running to the Union Station.



MAP SHOWING PROPOSED TERMINAL OF WABASH R. R. AT ST. LOUIS EXPOSITION, WITH SIGNALING ARRANGEMENTS.

All shuttle train business will be handled from the station at the corner of De Baliviere and Lindell Aves., which is directly opposite the main entrance to the World's Fair. The tickets will be collected at the turnstiles before passengers enter the trains. Shuttle trains will be made up of specially constructed cars without steps, having transverse seats extending the full width, with doors on either side at each seat. They will be entered from elevated platforms. By running these trains at two-minute intervals, it is estimated that the road can handle 36,000 people per hour with 1,200 people on each train. In operating these two tracks, trains will head in, and an extra engine will couple on to the rear to carry it on its return trip. The engine which brought the train in will then become the extra engine for the next train by pulling out and standing on the crossovers at A.

De Baliviere Ave. will be lowered (for the use of pedestrians only) during the Exhibition. The street car terminals will be located just north of the Wabash terminal. This street will probably be made 300 ft. wide south of the tracks, thus giving a broad plaza for the entrance and exit of those entering or leaving the fair grounds. Passengers from the through main tracks will be discharged from trains between Tower No. 2 and De Baliviere Ave, and will walk west on platforms to stairs shown, where they will descend under tracks and enter depot or plaza as desired. The same arrangement will hold on their exit.

Besides the interlocking machines shown, at Towers No. 2 and No. 3, a machine will be placed at Tower No. 1, near Union Ave., about 1,500 ft. further east. Tower No. 1 will have 32 levers, Tower No. 2 will have 52, and Tower No. 3, at Forsythe Junction, 40. The total distance between the interlocking limits will be about one mile; beyond this block signals are to be installed from the Union Station to Page Ave.

The West Belt Junction at Page Ave. is the connection of the West Belt of the Terminal Railroad Association of St. Louis, and affords a new route via the Merchants Bridge & Wabash R. R. to the World's Fair grounds. The other route is via either the Merchants Bridge or the Eads Bridge to the Union Station, from which place passengers can go to the Fair grounds by Wabash R. R. shuttle trains, street cars and other means of transportation.

SMOKE PREVENTION.*

By R. P. King, C. E.†

The cities of northern Indiana have been so long favored with abundance of natural gas for domestic and mechanical purposes that the sudden transition from a comparatively clear atmosphere to an exceedingly smoky one is like the rude awakening from a pleasant dream. All coal may be roughly divided into two classes: Anthracite and bituminous. Anthracite coal burns with little or no smoke, and its compulsory use has in some cities been an easy solution of the smoke problem. But in cities as far removed from the anthracite region as Indianapolis, the use of bituminous coal is imperative and relief must be sought through some other means.

Chemistry tells us that the products of combustion are: Water, carbonic oxide, carbonic acid, and sulphurous acid. In all flue gases we have present besides these, oxygen and nitrogen, due to an excess of air. These products are all practically colorless, so that the presence of smoke is in some way due to imperfect combustion. Tests by Hoadley show the solid portion, or coloring matter, of smoke to be 81% carbon, 7% ash, besides several other elements in lesser quantities, which need not be mentioned here. Smoke, therefore, is due to the presence of unconsumed carbon. In tests made by the Cleveland & Pittsburg Ry., in every instance when smoke was blackest, there was found to be the greatest percentage of free oxygen in the product, showing that something besides the mere presence of oxygen is necessary to prevent smoke.

Smoke prevention is by no means a new subject. The original smoke devices had in view the idea of a great saving by using the carbon lost on the smoke. As a matter of fact, this loss is less than 1%; probably 0.3%. As early as 1669 we have a record of a stove built with a downward draft to consume smoke. This was not suitable for furnaces. About 1785 James Watt started the ball by patenting a smoke consumer, admitting air through an opening in front of the furnace door. Ward (1792) drew his smoke through water by means of a bellows; Losh divided his furnace into two parts lengthways, firing each side alternately; Nevil (1824) patented a fan fixed in the flue to induce the draft; the steam jet was patented in 1838; the down-draft furnace with water grate in 1837; double combustion about the same time; the chain-grate stoker in 1841.

MECHANICAL DRAFT.—This will prevent smoke under certain conditions. If properly installed, and using coal not excessively smoky, it will meet all requirements and with good economy; which, after all, is the real test. An example of mechanical draft with poor coal is the plant at the Riverside pumping station in Indianapolis, where the stack is exceedingly smoky. Here the smoke is passed through a spray of water precisely as Ward did in 1792. At this plant the draft is but ¼-in., which accounts for some smoke.

FIREBRICK ARCHES, CHECKERWORK, COKING CHAMBERS, ETC.—These methods, when carefully managed, will prevent smoking. Such an arrangement will smoke when firing up, until it gets thoroughly warm. Under this head might come the different methods of firing, such as alternate firing, coking, regular firing, and the like. In all of these the personal equation enters so strongly, as to seriously impair their reliability as smoke precenting devices.

DOUBLE COMBUSTION.—In a smoke prevention device exhibited at the Parry Buggy Works in November 1892, a deflection plate was placed in the breeching, in such a manner, that the gases from the lower half of the breeching were deflected and forced by a blower through a water spray and then blown in on top of the fire. At the time I was there, they were using a very poor quality of coal and the smoke was light in color, but readily perceptible. It struck me at that time, that perhaps a test with a set of smoke cards would show about the same average as under the usual method. This smoke consumer is now out of commission.

DEVICES FOR PREHEATING AIR.—These have been tried to prevent smoke, but unless they are of a rather complicated nature they will not be very successful. Hollow walls, pipes in the bridge wall, etc., can at best add but a few degrees of heat to the air passing through them.

DOWNDRAFT FURNACES.—These are an efficient means for the prevention of smoke.

ADMISSION OF AIR ABOVE THE FIRE.—This is by far the simplest device for preventing smoke. At Tomlinson Hall, in this city, a blower is used to furnish the air, and a 5-in. pipe is connected with the furnace about 12 ins. above the fire. This device is marked "patented"; I wondered if the original Watt patent still protected it.

The same end may be accomplished with a steam jet. The simple addition of a steam jet or a blower can be made to existing boilers at slight expense, the operating cost is little, and the results are fairly good.

THE MECHANICAL STOKER.—This device, with or without mechanical draft, is a good solution of the smoke problem. The boiler plant at Arthur Jordan's produce house in this city is equipped with the Huff stoker. The boilers are in the basement of the building and have such a poor location that it would be hard to imagine a more difficult place to put a smoke device in. In this case a steam jet is used in connection with the stoker, and there is little or no smoke.

There is at present being carried on by the Indianapolis Water Co. a series of experiments on burning pulverized coal. In this system no grate is used, the coal being fed by an air blast and burned directly at the nozzle. Experiments (covering several months) in burning coal dust, by the writer at this same plant, a year ago, and using an independent stack, showed a practically smokeless combustion.

I do not care to take up patent fuels as their use has not been a commercial success.

I have not said anything about the efficiency of these devices. When we say efficiency, we should put a broader interpretation on the word than that relating solely to smoke prevention. The blower is naturally more efficient than the steam jet, and operates upon the fire in the same way. The stoker is as good a smoke device as either and shows a far better economy. The engineer must cut his garment to suit the cloth here as in other things. First cost enters in; repairs, prejudice, and a thousand and one other conditions. This paper has outlined the means available and the results in a few cases. Smoke prevention is simply a matter of competent application following a real desire to do away with this nuisance.

*Abstract of a paper read before the Indiana Engineering Society at its annual meeting at Indianapolis, Ind.

†Brossman & King, Consulting Engineers, Lemcke Building, Indianapolis, Ind.

THE HENNEPIN CANAL.

By James C. Long, M. West. Soc. C. E.†

This canal, officially known as the Illinois & Mississippi Canal, is intended to be a link in a waterway from Lake Michigan at Chicago to a point on the Mississippi River at the mouth of Rock River, 4 miles below the city of Rock Island, Ill. It is being built by the United States, and is

*Abstract of a paper read at the annual meeting of the Illinois Society of Engineers and Surveyors, Jan. 20 to 22, at Champaign, Ill.

†U. S. Assistant Engineer, Princeton, Ill.

under the general charge of Capt. C. S. Riche, Corps of Engineers, U. S. Army. The feeder line and western section are under the local charge of L. L. Wheeler, U. S. Assistant Engineer, and the eastern section is under the local charge of the writer. The canal begins at the great bend of the Illinois River, 1¾ miles above the town of Hennepin, Ill., proceeding thence 62 miles by the Bureau Creek Valley and over the summit to Rock River at the mouth of Green River, near Colona, Ill. Thence by slack water down Rock River 8½ miles, and by canal around the lower rapids of Rock River, 4½ miles, to the Mississippi River, making a total distance from the Illinois to the Mississippi River of 75 miles, and 193½ miles from Chicago to the Mississippi River. The canal is 80 ft. wide at water surface, and 7 ft. deep. It has lock chambers 170 ft. in length and 35 ft. in width, capable of passing barges of 600 tons burden.

The summit level is about 11 miles in length, and the distance from its eastern end to the Illinois River is 18.4 miles, with a difference of level of 196.4 ft., which is overcome by 21 locks. The distance from the western end of the summit level to the Mississippi River is 45.6 miles, and the difference in level of 100 ft. is overcome by 11 locks. The summit level is fed by a navigable feeder, which is of the same size as the main canal, and 29 miles long, beginning near Sterling, Ill., where water for the feeder is obtained by damming Rock River. A lock is located at the head of the feeder as a guard lock, also to enable boats to pass from the feeder into the river and back, at the different stages of the water in the river. The dam located here also creates slack water in Rock River, enabling boats to navigate it as far as Dixon, Ill., giving that place (as well as Sterling) water connection with the canal.

Work was begun on the canal in July, 1892, on the Mississippi near the mouth of Rock River, and the 4½ miles of canal around the lower rapid of Rock River, with slack water in the river above, was completed and formally opened to navigation April 17, 1895. Since that time it has been largely used by coal boats from the mines on Rock River. The feeder and the rest of the canal is still under construction, and is about 75% completed. The original eetimate of the cost of the whole improvement was in round numbers $7,000,000, but owing to various unavoidable causes it will cost something more than this.

The masonry in the large number of structures, such as locks, arch culverts, abutments and piers of railway, highway and aqueduct bridges, has all been constructed of concrete and has demonstrated its superiority over ordinary masonry, both in stability and economy of construction; also in rapidity of execution. The walls of 21 locks on the eastern section, containing on an average 2,500 cubic yards of concrete masonry each, were built in an average of ten days time each, working three shifts of 8 hours per day.

As stated above, this canal is a link in a waterway from Chicago to the Mississippi River near Rock Island. Another link is the Illinois & Michigan canal, belonging to the State of Illinois, extending from the Chicago River, about 5 miles above its mouth, to La Salle. It is 96 miles long, 60 ft. wide at water surface, 36 ft. wide at bottom in earth excavation, and 48 ft. wide in rock. Its locks are 110 ft. long and 18 ft. wide, with 6 ft. of water over the miter sills. It is navigable by boats 97 ft. long, 17 ft. 6 ins. wide and 5 ft draft. It will be seen by these dimensions that the Hennepin Canal cannot reach its usefulness until the state canal is enlarged, which it is supposed will be done by the United States after the Hennepin Canal is completed, two years hence, by agreement with the State of Illinois.

A CANTILEVER BRIDGE OF 1,800-FT. SPAN is projected to carry the Intercolonial Railway across the Straits of Canso, between Nova Scotia and Cape Breton. According to the present intentions the approach to the bridge on the Cape Breton side will be made by branching off to the north at a point on the I. C. R. a few miles east of Point Tupper holding the high level along the ridge at the rear of Hawkesbury to the Hastings end of the bridge and crossing to Cape Porcupine on a level at an elevation of about 160 ft. above high water. The connection from Cape Porcupine end of the bridge to the I. C. R. will be made by building a spur along the side of Cape Porcupine to a point on the I. C. R., near Harbor au Bauche station, thus overcoming the greater part of the present heavy grades on the I. C. R. from tide water level at the Strait and thence west over the summit between Mulgrave and Harbor au Bauche station. According to the preliminary plans the bridge will be 4,370 ft. long, including the viaduct approaches. The bridge proper will consist of two cantilevers carried on piers sunk in 80 ft. of water, and a central suspended span. The shore arms of each cantilever is 600 ft. long; the river arms are also 600 ft. long, and the suspended span is 600 ft., making the total length of the center span 1,800 ft. The bridge is to have a clear height of 150 ft. above the water. The engineers of the bridge are Waddell & Hedrick, of Kansas City, Mo., and they are now engaged in preparing the working plans. The bridge is projected by the Strait of Canso Bridge Co.

THE COMMITTEE OF THE NATIONAL GOOD ROADS Association met at Washington, D. C., Jan. 23 and 24, to present to Congress the resolutions adopted by the National Good Roads Convention, held in St. Louis, Mo., April 27, 28 and 29, 1903. The resolutions indorse the work of the Office of Public Road Inquiries of the U. S. Dept. of Agriculture, and request that this office be enlarged into a bureau of the Department of Agriculture with sufficient appropriations at its disposal to extend its field of usefulness. The resolutions ask a Federal appropriation for the improvement of the common highways, and recommend the co-operation of the township, county, state and National governments in the furtherance of road improvements. The Committee presenting this resolution was composed of one person from each State of the Union, and from this Committee were selected eight speakers to address the Senate Committee, and a like number to address the House Committee of Agriculture. The speakers favored the immediate passage of either the Latimer or the Brownlow bill appropriating $24,000,000 for road building, to be distributed among the states according to their respective populations, upon condition that each state receiving its pro rata shall add an equal amount to be used in good road construction. Mr. Halbert P. Gillette, of this journal, representing the State of New York, was one of the speakers before the Senate Committee.

The Committee as a whole called upon President Roosevelt, who, in a short speech, expressed himself in favor of the movement for National aid in road building.

MEXICAN ASPHALT DEPOSITS are to be developed by the Pan-American Asphalt Co., organized by Mr. Amzi L. Barber and others. The asphalt deposits are located near the Laguna de Tameahua, between Tampico and Taxpam on the Gulf coast, so that access to the sea for shipment will be easily effected. The material is said to be free from the mineral salts which cause the deterioration of Trinidad asphalt when exposed to water.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a head-on collision near Peoria, Ill., on Jan. 19 between a wrecking train and a train of empty cars being handled by a switch engine. Three persons were killed and three others injured. A misunderstanding of orders is said to have been the cause of the accident.

THE FALSE-WORK SUPPORTING A CONCRETE-steel arch over Cahokia Creek, near Edwardsville, Ill., collapsed on Jan. 16. The structure was located on the line of the Chicago, Indianapolis & St. Louis Short Line. Two arches of a bridge had been completed and the third was nearly done when the false-work under the third arch gave way. The false-work gave signs of failure before the final collapse, so that the workmen had time to save themselves.

AN EXPLOSION OF GAS in the Harwick mine of the Allegheny Coal Co., at Cheswick, Pa., on Jan. 25 resulted in the death of some 184 men. The explosion occurred at about 8 o'clock in the morning and practically every person in the mine was killed. In addition a number of persons at work on the tipple or who entered the mine to rescue the men below also met death. The mine was opened only three years ago and the workings had advanced only about a half mile from the shaft bottom, which was 220 ft. below the surface. No definite cause is assigned for the explosion. Among the victims is Mr. Selwyn M. Taylor, the engineer who laid out the mine, who was killed in an attempt to rescue the imprizoned workers.

THE BUTLER TYPHOID EPIDEMIC had resulted in 105 recorded deaths and a total of some 1,400 or more cases up to Jan. 21, at which time 400 to 500 patients were still in bed and the relief committee had 81 nurses in its employ. A sanitary survey of all the wells in Butler is being made under the direction of Dr. Wilmer R. Batt, State Quarantine Officer. Two new cases were reported on Jan. 21.

TYPHOID FEVER OUTBREAKS, some of which are of a serious epidemic character, have been reported during the past few weeks at Rensselaer, N. Y., Kittanning and Sharon, Pa.; Columbus, O.; Leadville, Colo., and Montreal, P. Q., and vicinity. Pittsburg continues to have a large number of cases.

DEATHS FROM EXPLOSIONS IN MINES during the past four years have been 26.4% of the total accident mortality in the metal mines of Colorado, 20.3% in Missouri, 19.6% in Montana, and 12.7% in the copper mines of Michigan, according to the "Engineering and Mining Journal." The comparative mortality from accidents in metal and in coal mines, 1898-1902, is given in the following table:

	Total number employed.	Total number killed.	Rate per 1,000
Montana (all mines, but mostly metalliferous)	63,270	226	3.57
Missouri lead and zinc mines	46,523	163	3.50
Pennsylvania anthracite mines	722,621	2,096	2.90
Colorado metalliferous mines	181,930	521	2.86
Pennsylvania bituminous mines	541,248	1,479	2.73
Michigan copper mines (Houghton county)	65,119	163	2.50

From this it appears that 234 miners lost their lives by explosions in the metal mines of the states above enumerated. The percentage of fatal accidents in the anthracite coal mines due to explosives has averaged about 9% of the total fatalities, as against 22% in the metal mines. This difference may be explained by the fact that dynamite is used in metal mines and black powder in coal mines.

THE TYPHOID OUTBREAK AT WILLIAMSTOWN, Mass., some weeks ago, has been reported on by the Massachusetts State Board of Health. No common cause for the 15 cases occurring the latter part of 1903 has been established to the satisfaction of the board, which feels confident that the outbreak should not be attributed to a can of cream from North Adams, a theory reported in these columns some weeks ago.

COMPULSORY SEWAGE PURIFICATION in Minnesota, in the case of all new sewerage systems, seems to be required by a resolution adopted on Jan. 12 by the State Board of Health. The resolution, according to reports, will require septic tanks and filter beds as a part of all sewerage systems built after Jan. 1, 1905, the plans for purification works to be subject to approval by the board.

THE EMPLOYMENT OF AN ENGINEER to make plans and estimates for garbage collection and disposal at Montclair, N. J., has been recommended by a special committee composed of town officials and citizens, with Mr. John R. Livermore as chairman and Mr. M. N. Baker, of the editorial staff of this journal, as secretary. The recommendation, however, is coupled with a recognition of the fact that other pressing town needs may require a postponement of action on garbage disposal. No immediate action on the report is probable. Mr. D. D. Duncan is Chairman of the Town Council of Montclair.

EXPORTS FROM THE UNITED STATES in the calendar year 1903 amounted to nearly one and one-half billion dollars in value. The total as given by the Department of Commerce and Labor was $1,484,668,127. This exceeds the record of any previous year, the nearest approach to it being in 1900 when exports reached a value of $1,477,946,113. Comparing last year's export record with those of 10 years, 20 years and 30 years ago, we find that in 1893 and 1883 the exports were about 900 million dollars and 800 million dollars, respectively. In 1873 they amounted to 568 millions.

Imports in 1903 were just short of the billion dollar mark, which mark has never been reached in any calendar year, although it was passed in the fiscal year ending June 30, 1903.

A HIGH PRESSURE GAS DISTRIBUTION SYSTEM at St. Louis is being installed by the Laclede Gas Light Co. of that city under the direction of Mr. W. A. Baehr, Engineer of the company. It is said that the system is intended to supply the whole city, which has an area of about 65 sq. miles. On the cast-iron mains of the city the pressure will not be over 5 lbs., but on the suburban wrought-iron pipes it will be from 20 to 80 lbs. For the city or medium pressure service a Connersville blower will be driven directly by a 300-HP. Westinghouse horizontal four cycle gas engine with two double-acting 16½ × 24-in. cylinders arranged tándem with a single crank. The fuel gas for the engine will be drawn directly from the city gas main, the engine being controlled by an automatic pressure governor which adjusts the engine speed in direct proportion to the demand for gas and in inverse proportion to the pressure in the distribution main. In addition, a centrifugal speed governor will be used. Electric ignition will be employed in the engine.

ENGINEERING NEWS

A Journal of Civil, Mechanical, Mining and Electrical Engineering.

Entered at the New York Post-Office as Second-Class Matter. Published every Thursday at St. Paul Building, 220 Broadway, New York, by

THE ENGINEERING NEWS PUBLISHING CO.

PUBLICATION OFFICE, 220 BROADWAY, NEW YORK.
CHICAGO OFFICE, 1636 MONADNOCK BLOCK.
BOSTON OFFICE, 170 SUMMER ST.

FOREIGN AGENTS.

C. MITCHELL & Co, Snow Hill, Holborn Viaduct, LONDON.
RUDOLF MOSSE, BERLIN and HAMBURG, GERMANY.
JOHN F. JONES, & CIE, 31 Rue de Faubourg Montmartre, PARIS.

SUBSCRIPTION RATES: United States, Canada and Mexico, One Year, $5.00; 6 months, $2.50: 10 weeks, $1.00. To all other countries in the Postal Union: Regular Edition, One Year, $8.00; Thin Paper Edition, One Year, $6.75. SINGLE COPIES of any number in current Volume 15 cents..

In requesting change of mailing address, state BOTH old and new address; notice of change should reach us by Tuesday to be effective for the issue of the current week. The number on the address label of each paper indicates when subscription expires, the last figure indicating the year and the one or two preceding figures the week of that year; for instance, the number 325 means that subscription is paid to the 32d week (that is the issue of Aug. 10) of the year 1905; the change of these figures is the only receipt, unless one is sent by special request.

ADVERTISING RATES: 20 cents a line. "Want" and "For Sale" notices, special rates, see page XXIV-XXIX. New copy for standing advertisements should be received one week in advance of publication: new advertisements, Monday morning. The pages containing "Want," "For Sale" and "Proposal" advertisements are held open until Wednesday at 10 a. m.

To meet objections made on the score of inadequate accommodations in the proposed Union Engineering Building, Mr. Andrew Carnegie, as was announced in our last issue, has raised his original gift of one million dollars to one and one-half million dollars. This very generous offer removes the objection hitherto made that quarters in the new building would be less commodious than those now occupied by the American Society of Civil Engineers. There is evidently, however, a decided division of opinion in the Society as to the proper course to be pursued. In our last issue we republished the statement made by the Society's Board of Direction, briefly setting forth the arguments advanced for and against the proposition. The whole matter is now to be submitted to letter-ballot, and each member is called upon to weigh carefully and conscientiously the merits of the case for himself and to act accordingly.

The arguments submitted on each side are doubtless sincere; and each side believes that its view expresses what is for the best interests of the Society, or for the best interests of the whole profession of engineering, as the case may be. No one will deny that the proposed centering of all the branches of engineering in one imposing and conveniently-located structure in the city of New York is a very radical departure from the conditions now existing in these several societies. An intelligent and wise co-operation under the opportunities presented by a more intimate relationship would undoubtedly be for the great and lasting benefit of the whole profession of engineering. But if this centering of societies is likely to lead in any way to contention in management, to a desire to control on the part of any one of the component parts, or to jealousy or improper rivalry, then it were far better that each society worked out its own future separately.

The altruistic among engineers will contend for the gain resulting from the first possibility suggested. The other possibility, we sincerely believe, is the more pessimistic; but the careful man will weigh every possibility.

One point that must not be lost to sight is the fact that a number of men professionally prominent belong to several of these Engineering Societies, and properly so. As the vote of the American Society of Civil Engineers may possibly decide whether this gift is to be available to any of the Engineering Societies named in the proposed deed of gift, it should not be forgotten that the interest of the American Society of Civil Engineers is not the only interest at stake in casting this vote, and that no matter how loyal any man may be to the Society in which he holds membership, he owes a higher loyalty to the profession as a whole, and the question what course of action will best redound to the honor and prestige of the engineering profession is one which should receive careful and serious attention.

Our columns will be open to correspondents who desire to present arguments in favor of either side, for the question is of such importance to the interests of the profession as a whole that it deserves full and fair discussion.

The need for adequate protection of the public water supplies of the State of New York is recognized in a bill just presented in the legislature of that State by Senator Stewart, of Ithaca. The bill provides for a State Sewerage and Water Commission of three members, to be appointed by the Governor for terms of five years each and each to receive a salary of $8,000 a year. One of the commissioners would be a competent civil and hydraulic engineer and one a competent sanitary engineer and bacteriologist. A secretary, clerks, inspectors and other permanent employees might be engaged up to a total of $15,000 a year, and engineers and chemists for temporary work as needed, provided the total annual expenditures of the commission did not exceed $75,000. The approval of the commission would be required for all plans for water-works and sewers, and improvements thereto, besides which the commission would have sanitary control of the waters of the State, with power to summon witnesses, administer oaths and pass upon alleged violations of laws against water pollutions. Such violations, when found, would be reported to the Attorney-General of the State for action. It would be the duty of the commission to investigate epidemics of typhoid fever, believed to be caused by impure water, and it would have power to compel any city or town to provide a new water supply or build water or sewage purification works.

There can be no question among engineers and sanitarians of the need of just such work as has been outlined in the foregoing paragraph, nor of the need of strong and competent men to administer it. It is a serious question, however, whether a new and independent commission should be established or the existing State Board of Health given a thorough reorganization and the necessary enlargement of powers to carry on the proposed work. The demand for the proposed commission is in itself a strong argument for the reorganization of the State Board of Health, for that body has for years been entrusted with some of the very duties which it is now proposed to lay upon the new commission; particularly the approval of plans for sewage disposal works.

The intimate relation between the usual work of State Boards of Health and that of the proposed commission is strongly in favor of reorganizing the former and increasing its powers. The multiplication of commissions is a thing to be avoided wherever possible; strengthening and infusing new life into old commissions, on the other hand, is always desirable. The history of the defunct State Sewerage Commission of Connecticut and the returns now being secured in New Jersey for the $20,000 a year which it is paying as salaries to the members of two sewerage commissions may well be studied in New York State at this juncture.

It should be distinctly understood that a reorganized State Board of Health for New York should be a working, rather than a political or ornamental body; that it should be composed as contemplated by the framer of the bill under discussion with the addition of a lawyer and a physician; that it should have control of everything relating to the health of the State, including the registration of vital statistics; that the members should be liberally paid for their full time; and last but not least, that the Board should be armed with all necessary legal powers to protect the health of the citizens of the State, and provided with ample funds for the maintenance of laboratories and the employment of the best engineers, chemists and bacteriologists in the land. Nothing short of this would comport with the sanitary needs and with the dignity of one of the greatest States of the nation.

The attention of all who are interested in preventing the spread of typhoid fever is invited to some remarks bearing upon the subject which we have quoted from the "Medical Journal," elsewhere in this issue. These remarks relate chiefly to the need of careful disinfection of the urine as well as the fæces of typhoid fever patients, and lay particular stress upon the fact that typhoid germs are most abundant in the urine after convalescence. The urine, therefore, of typhoid patients and convalescents should be subjected to the most careful disinfection. It should also be noted that public water supplies are in some respects in greater danger from typhoid infection than was supposed before it became known that urine was liable to be highly infectious. The lesson is obvious: Increased care should be given to the protection of water supplies, and particularly surface water supplies, from contamination by human wastes and efficient water purification plants should be installed as rapidly as possible on surface supplies, beginning with those most liable to pollution.

The lack of definite purpose and clear thought which characterizes much of the "metric system" propaganda was well illustrated in the discussion and vote on the subject by the American Society of Heating and Ventilating Engineers, at its annual meeting reported on another page. In the first place, the character of the respective remarks of advocates and opponents of "metricizing" the United States did not bear out the oft-repeated charge that the opposition is born of crass conservatism. The anti-metric speakers at the meeting in question based their opposition on a knowledge of both systems. Most of the pro-metric argument, on the contrary, was made by men who know the metric system only in the abstract, and their advocacy of the system was confessedly academic. The lack of a clear conception of ways and means is shown by the letter-ballot vote. The proposition "in favor of the adoption of the metric system as the legal standard of the United States" was lost by a vote of 34 to 45. The proposition "in favor of the adoption of the metric system in the departments of the Federal government" was lost by a smaller margin: 37 to 42. A third proposition, "in favor of legislation which would promote the adoption of the metric system," was carried, by 41 to 39. That is to say, a 14% majority of the voters does not want a metric legal standard, doubtless because of a vague feeling that this might hurt business. But part of this majority is perfectly willing to hurt the business of the government by saddling it with a system foreign to the country in general. Finally, enough voters find consolation in the indefinite proposal to convert the common people, by legislation "which would promote the use" of the system, to make a majority in favor of this proposal.

As in the case of the other votes which have been taken on this subject, the vote under consideration is divested of any decisive value by the fact that it represents only a small part of the membership. Of 168 members entitled to vote, over half were too indifferent to the matter to take trouble of casting any vote at all. It is safe to say that these non-voters are satisfied with our present weights and measures and consider the continued metric propaganda the mere pursuit of a fad.

THE USE OF SAFETY EXPLOSIVES IN CITY WORK.

One year ago (in our issue of Jan. 22, 1903) we drew attention editorially to the fact that there are now on the market several high power safety explosives which do not freeze, and are as effective as dynamite for equal expenditure of money.

As we then said, statistics of accidents from dynamite show that nearly all the accidents occur in the winter months when dynamite requires

thawing in order to be used. This has been illustrated during the present season by a considerable number of accidental explosions of dynamite reported since the advent of severe winter weather.

A year ago we predicted that the day was not far distant when safety explosives would be used exclusively by contractors doing city work, if for no other reason than to insure themselves against the risk of damage suits.

At that time no safety explosive was in extensive use in any of the large cities of the United States, so far as we know, although safety explosives had been for years in growing use in railway and in quarry work. This year finds the safety explosives rapidly gaining a foothold in at least two of the larger cities. In Philadelphia, on subway work, in New York, on the great work of the New York Central & Hudson River R. R., and elsewhere on smaller excavation jobs, safety explosives are either on trial or in accepted use.

A representative of this journal recently visited the site of the excavation now in progress in the yards of the New York Central & Hudson River R. R., where dynamite and the safety explosive, Jovelte, have been used side by side. The rock is a tough mica schist in which lift-shots were being fired to open up a face. Charges placed in the drill holes frequently lie for some time before firing, and the holes fill with snow water, making in all a most difficult condition for the use of any explosive. Under these conditions sticks of Jovelte were charged, tamped, and subsequently fired by electricity, with an effect that to all appearances was superior to that produced by dynamite. The rock was thoroughly shattered, but not scattered, and no hole misfired even under the severe conditions. We mention these facts somewhat in detail because it has been argued that safety explosives of the picric acid type cannot be used under water, and because it has seemed to us that of all places where a safety explosive should be used excavation along the line of railway tracks within a city is the place. As was pointed out in our editorial of a year ago, the use of explosives within a city's limits should be hedged about with every possible precaution to insure the safety of the public. But in no place is the public so completely at the mercy of chance as when traveling in cars near works where high power explosives are in use.

A stick of frozen dynamite will not explode, and, where dynamite freezes in a charged hole, it often happens that a portion of the charge explodes, hurling fragments of the frozen and unexploded dynamite in all directions. These fragments may fall upon the railway tracks, to thaw and subsequently explode by accident, or what is still more likely, some of them may find their way into the stone cars and there do equal damage by exploding in transit. It is beyond the power of any man to predict when and where an explosion of such scattered sticks of dynamite may occur, but, with the perversity of inanimate nature, a portion of such a stick may readily wreck a passenger train, in spite of every human precaution.

Dynamite has done, and will long continue to do, a great work, but its legitimate field is now outside the limits of a populous city; for then, in case of accident, the workmen alone are jeopardized. Even were the safety explosives more expensive, which we understand they are not, the added first cost would represent only a small premium paid to insure the public safety.

ECONOMY IN RAILWAY OPERATION.

The brief paper with the above title read at the meeting of the Western Railway Club last week and printed in abstract elsewhere in this issue, raises questions well worth study. The author of the paper, Mr. W. M. Waggoner, starts out with the statement that railways are operated with a great deal of waste. He gives reasons why the present organization cannot prevent this waste, and prescribes a "Bureau of Economies," whose business it would be to find out where money could be saved.

There will be little dissent from the proposition that much preventable waste exists in the railway service; but that a separate Bureau of Economics would be an effective method of reducing this waste is by no means so clear. What is proposed is a department with no real authority, to act only in an advisory capacity. Now for a man to give advice it is essential that he shall know more of the subject than the man to whom the advice is given. If the head of the Bureau of Economies were competent to advise the Master Mechanic, the Chief Engineer, the Division Superintendent and the Superintendent of Bridges and Buildings where each could save money in his department, he would be competent to fill any position from a Vice-Presidency to the Chairmanship of the Board of Directors.

The fact is that the place where economics should originate is with the head of the department himself. An accounting officer can check cases of dishonesty or of gross inefficiency; but he cannot originate new methods of economy. If he could, the auditor's office might be at once transformed into a Bureau of Economies.

The real reason why railways are not economically administered is well stated in the paper referred to. We quote as follows:

> Railways are directly administered by men who have no personal interest in the question of economies and who have all they can do to keep things moving. The official in charge, being on a salary, may be looking for another position to-morrow. A change of management nearly always makes more or less changes in minor officials and often a complete one in heads of departments. It is not reasonable to expect men under such circumstances to lie awake nights or to work overtime trying to save dollars.

These are facts, bluntly stated, and so long as these facts exist it is idle to expect economical railway administration, or to scheme out any plan whereby an outside bureau can initiate economies. The real wonder is that on many railway systems the results are as good as they are when one considers the frequent changes and uncertain tenure of office of the executive heads. Why should a Superintendent of Motive Power, for example, exert himself to save money for the company if he knows that he holds his position solely through his "pull" with the higher officers, and that when a change occurs, which may happen at any time, some other man who has a pull with the new management will take his place?

It is idle to expect that men working under such conditions will do any more than routine requires them to do. As a matter of fact—and this is also set forth in the paper above referred to—the routine duties absorb so much of the time and energy of most railway officials that they have little left to devote to the study of possible economies. Where this condition exists, it is one that likewise needs a remedy. The responsible head of a department ought not to be bound down to routine details. He should have time enough to consider the larger problems before him and to work out plans for improving the service. If he is given this freedom, and if he has the necessary ability and the assurance that exertion in the company's service will receive due appreciation and reward, there is no reason why affairs under his direction should not be run on as economical a basis as if he were working for a manufacturing firm.

In this connection it may be said that the greatest source of waste in the railway service is seldom in the purchase at excessive prices or in wasteful use of materials. It is in wrong methods of work, in doing things in expensive and uneconomical ways; in delay in adopting improvements, in neglect of maintenance, in manufacture of useless red tape, and in doing business which costs more than it yields in return.

All these things can be remedied only by intelligent and efficient management, and from the inside, not from the outside.

Mr. Waggoner in his paper alludes to defective accounting methods and makes the broad assertion that not a railway company in the country can tell the actual cost of any particular operation, or of any particular train service.

A good illustration of this fact is the operation of branch lines of thin traffic. Where such lines are operated by independent companies, it is as a rule found very difficult to make them pay. When they are absorbed by the company owning the main line, their revenue and expenses are generally not separately reported, and no one knows whether the property yields a loss or a profit.

Of course, it is true that to permanently maintain separate accounts for all the different parts of a great railway system would be a piece of useless red tape, involving great and needless expense. There is no reason, however, why accounts should not be kept for a limited time of the receipts and expenses of any given part of a system, and the separate accounting could stop when the desired information was obtained. Only with accurate knowledge of what a given line is yielding in the way of traffic and costing for operation and maintenance can an accurate judgment be formed respecting the train service that may be properly afforded, and the rates that may equitably be charged for fares and freight. It is universally recognized that "cost of service" ought to be considered in any equitable adjustment of railway rates; yet accurate determination of the actual cost of handling any particular class of traffic is very seldom made.

LETTERS TO THE EDITOR.

Of Interest to Engineers.

Sir: I copy below a want advertisement that appeared in the columns of Engineering News of Jan. 14, 1904.

Comment is unnecessary, but it should be food for thought to the engineering profession:

"WANTED.—Young engineer with instrument, on railroad work; salary, $45. Address "W. M. P." Box 82, Burnsville, W. Va."

Fellow engineers! Are you, too, helping to degrade our noble profession?

Yours truly, Nat C. Yuille.

Montgomery, Ala., January 20, 1904.

What Makes a Good Wash or Paint for Surfacing Concrete?

Sir: Can you give me the proportions for a good cement wash or paint? Something permanent that will make concrete a uniform color. Yours truly,

Paul Coleman.

Duke, Ala., Jan. 16, 1904.

(About a year ago we invited our readers to submit suggestions as to satisfactory methods of giving concrete work a finish pleasing to the eye. The use of face mortar containing iron oxide and the tooling of the face were both suggested. It is noticeable that the tooling of concrete, either by pneumatic hammers or by hand, is coming rapidly into favor. The use of some sort of stain in the face mortar thus far seems to have had few advocates. Can any of our readers cite instances where iron oxide stains have proved satisfactory or the reverse? It has been claimed that large walls faced with red mortar become mottled in appearance, due to chemical changes in the iron oxide.

Will a thin grout containing iron oxide, or the like, give a uniform color to the face of a finished concrete wall?—Ed.)

Fixed Signals with the Train-Order System of Railway Operation.

Sir: In your edition of January 14, you say: "It is one of the inherent defects of the train-order system that the absence of a signal means safety, etc."

This is an error. Rule 27 of the Standard Code of Train Rules of the American Railway Association, reads as follows:

> A signal imperfectly displayed, or the absence of a signal at a place where a signal is usually shown, must be regarded as a stop signal, and the fact reported to the ..... (superintendent).

Rule 221, which is one of the rules for movement by train orders, contains the following paragraph:

> Operators must have the proper appliances for hand signaling ready for immediate use if the fixed signal should fail to work properly. If a signal is not displayed at a night office, trains which have not been notified must stop and ascertain the cause, and report the facts to the ..... (superintendent) from the next open telegraph office.

Yours truly, W. F. Allen,

Secretary American Railway Association.

24 Park Place, New York, Jan. 19, 1904.

(We give space with pleasure to the correction, and may add that the standard code also provides that "a fixed signal must be used at each train order office." Where this rule is carried out, Rule 27 above quoted would apply; but on a large proportion of American railways, if we mistake not, fixed signals at train-order stations are an unknown luxury. The station agent when he has

orders to deliver to a train hangs out a flag by day or a lantern by night, and in the absence of this signal a train proceeds without stopping.

This was what we had in mind in penning the sentence to which our correspondent takes exception; but we freely admit our error in saying that the absence of fixed signals is an inherent defect of the train-order system.—Ed.).

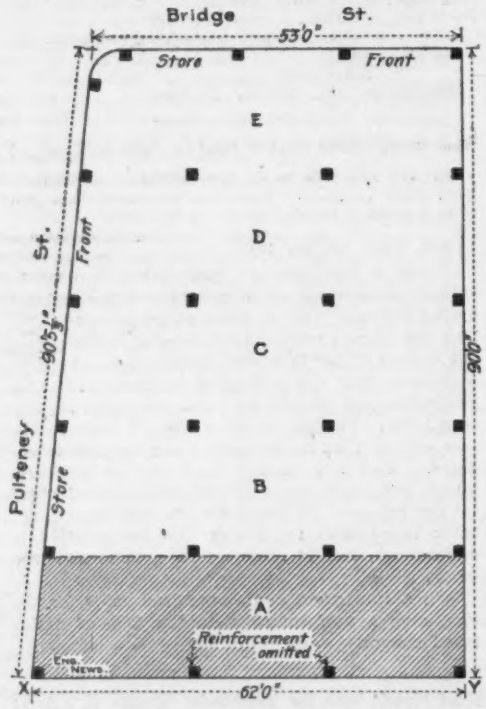
The Architects' License Law in Illinois and How It Works in Practice.

Sir: Referring to Mr. De Knight's letter and your short editorial comment on same in the issue of Jan. 14, on the subject of licensing architects and engineers, I submit the following upon the operation and effect of the architects' license law in the state of Illinois, which you mention.

It is true that Illinois has a law requiring architects to be licensed, but only a small proportion (7% in 1900) of those holding such licenses ever took or passed an examination. When the law went into effect in 1897 a period of six months was allowed during which time any one who made affidavit that he was engaged in the practice of architecture received a license upon the payment of $25. The natural result was that scores, if not hundreds, of builders, contractors and youthful draftsmen graduated into licensed architects.

The Board of Examiners may also waive the examination in cases where the applicant satisfies them that he is possessed of the necessary qualifications to practice architecture.

Furthermore, the graduates in architecture or architectural engineering of the University of Illinois are exempted from the examination (nothing said about similar courtesies to graduates of Cornell, Mass. Inst. of Tech., Columbia and other universities).



Plan of Wing & Bostwick Building, Showing Extent of Failure.

Section A and most of rear wall X-Y gave way.
No columns were injured except the columns between Sections A and B in third story. Roof of Section B fell upon third floor, but latter did not give way.
First and second floors in Section B were uninjured. All girders between Sections A and B held, except in roof.
All of building in front of Section B was uninjured.

But for all applicants who fail without the pale of these three exempted classes, there is a three-day examination prescribed, covering calculation of strain sheets and sections, construction, strength of materials, sanitation, design and mechanical plant of buildings, about the résumé of a four-year course in architecture. The number of licenses issued as the result of passing this examination are few.

As a matter of fact, the engineering features of structures of any magnitude are usually turned over by the architects to consulting engineers, but the absurd fact remains that these engineers who design the structural portions of buildings for architects are debarred by law from executing such works for the public or client direct. Thus it is that the law which has for its ostensible object the protection of the public from faulty construction, in practical operation prevents the engineers who furnish the elements of security to buildings from handling the work direct, and gives the architect a monopoly of engineering as well as architectural work on new structures.

A reversal of the law would better safeguard the public, if not the architects. "Justus."

Chicago, Ill., Jan. 18, 1904.

Failure of a Concrete-Steel Building at Corning, N. Y.

Sir: Will you please correct that part of your statement in your issue of Jan. 7 concerning the concrete-steel building of Wing & Bostwick, Corning, N. Y., in which you say the entire rear half of the building, including the rear portion of the floors and the rear wall, collapsed.

You will see by the sketch plan, which we enclose herein, also by referring to the photographs, which you publish, that not one-fifth of the building is injured in any way, instead of the entire rear half, as stated in your article. We have given you on this sketch plan some memoranda which will enable you to determine just the extent of the failure. Respectfully yours,

Pierce & Bickford.

Elmira, N. Y., Jan. 11, 1904.

A Rule for Finding Log. Functions of Small Angles.

Sir: The following formula is convenient for finding the log. sine of an angle not given directly in the tables, and where interpolation would be erroneous:

$$\log \sin a = \log \sin A - \log A \text{ (reduced to seconds)} + \log a \text{ (reduced to seconds)};$$

where

a = angle for which log sin is desired;
A = angle slightly greater or less than a and the log sin of which may be found directly from the tables.

(This rule applies only to very small angles, where sin a = a is sensibly accurate.—Ed.)

Example 1.—From "one-second" tables find the log sin of 0° 01′ 23.5″.

Then a = 0° 01′ 23.5″ = 83.5″;
A = 0° 01′ 23″ = 83″.

log sin A	6.6046529
log A	1.9190781
	4.6855748
log a	1.9216865
log sin a	6.6072613

But by interpolation it would be 6.6072535.

Example 2.—From "ten-second" tables find the log sin of 0° 01′ 23.5″.

Here a = 0° 01′ 23.5″ = 83.5″;
A = 0° 01′ 20″ = 80″.

log sin A	6.5886648
log A	1.9030900
	4.6855748
log a	1.9216865
log sin a	6.6072613

But by interpolation it would be 6.6065682.

Example 3.—From "one-minute" tables find the log sin of 0° 01′ 23.5″.

Then a = 0° 01′ 23.5″ = 83.5″;
A = 0° 01′ = 60″.

log sin A	6.4637261
log A	1.7781513
	4.6855748
log a	1.9216865
log sin a	6.6072613

The writer found this method necessary in connection with a very careful survey connecting state triangulation points and involving long lines and close angles.

Logarithmic cosines, tangents and cotangents may be deduced by the same principle.

Yours truly, Albert I. Frye.

723 Central Building, New York, N. Y., Jan. 4, 1903.

Concrete Mixing in England.

Sir: I superintended, about a year ago, the construction of some 20,000 cu. yds. of concrete retaining walls in the north of England. Half of it was mixed by hand and half by gravity mixer.

The specification called for 1 part cement to 8 of beach ballast (sand and gravel). Sand is seldom specified separately in England, except as sufficient to fill interstices. The ballast was measured in bottomless boxes ("Gages"), about 1 ft. deep, holding 24 cu. ft.; the cement in boxes with bottoms and handles, and holding 3 cu. ft. Two sides of the gages are prolonged to form handles for lifting off and the sides are battered out to the bottom. The ballast was deposited in heaps about 20 ft. from face of wall, and a platform of rough planks laid close to wall. The gages lie on the platform next the heap, and two men constantly fill them with ballast, spreading the cement in a layer on top. The regular "hand gang" consisted of ganger (boss), 8 mixers, 2 men filling gages, and 1 man spreading in wall.

The mixers stand in two rows and turn the mixture continuously along towards the wall, the last pair putting it into the wall direct. Water is thrown on with a bucket at the third pair, and the concrete is thus mixed twice dry and twice wet.

This gang would put in about 30 cu. yds. per day; costing from 2s. to 2s. 6d. per cu. yd. For small walls up to 8 ft. high, and in awkward positions, this method was found most economical.

Using the gravity mixer, the ballast h[illegible] was deposited at the level of the top of the wall, a[illegible] the mixer hung over the face as close up to the new w[illegible]k as possible. The ballast was loaded in low hand [illegible] holding 24 cu. ft., half full, then a layer of cement, [illegible] filled to top with ballast. The cart was pushed to [illegible]ixer and tipped gradually into it. At the bottom of [illegible] mixer to receive the charge were two tipping bucke[illegible] on small cars and a short length of rail. The full [illegible]ket was taken away by a traveling crane and tipped [illegible]nto wall, and the empty bucket pushed under and filled ready for the crane on its return. The gang consisted o[illegible] 1 ganger, 6 men filling hand carts, 1 man shifting bucke[illegible], 1 crane driver, 1 crane boy, 1 banksman and 2 men [illegible]preading concrete; average cost 1s. 3d. per cu. yd.

The general output was 60 cu. yds. per day, and they were generally stopped for lack of frames to [illegible] or because it was not safe to put more on the wa[illegible] as one face was free and required considerable holding up, being from 10 to 36 ft. high. "Plums" were allowed to be used, 6 ins. apart, and in my opinion they greatly strengthened the wall as long as they were angular. Personally speaking, I cannot see the object of breaking stone up so small in order to stick it together again; and the only favorable point seems to be that a man can handle small stone with a shovel.

I superintended the construction of 10-ton blocks for harbor work some years ago, and found that those made with hand size rubble and 4 to 1 mortar were much superior in strength to those made from beach ballast concrete with same quality of cement (about 8 to 1). The reason to me seems evident. If we imagine two frames, one filled with rough angular stone of large size and one with ballast, or broken stone and sand, it would require very little demonstration to show that when the frames were removed the rubble would remain practically vertical, owing to its natural bond, while the small stone and sand would run to a pretty flat slope.

I have also made first-class concrete from broken brick; indeed, I believe any material free from clay or silt will make good concrete as long as the cement is of good quality. Engineers often specify expensive sand and broken stone when local material would answer just as well and cost half the money. Yours truly,

Harold Berridge.

1 Spencer Place, Brooklyn, N. Y., Jan. 16, 1904.

Concrete Mixing Processes.

Sir: Concrete now plays so important a part in masonry structures that the space you give to the expression of views by practical men concerning its preparation is profitably employed.

In making concrete, the proportion of the ingredients being decided upon, the problem is, how shall these ingredients be thoroughly intermixed in the least time, and in a manner permitting the inspector to check quantities with least chance of error. At least, this is the problem from the engineer's side of the question; what it is from the contractor's side, is one between himself and his own conscience.

On the score of quantity of finished product, I do not think it is worth while to discuss any of the different methods suggested by your correspondents, more particularly as the factor of placing and tamping work have to be introduced, as well as the mixing. So the question at issue is, as just stated, how to secure accuracy of proportions and thoroughness of incorporation with the greatest ease, certainty and rapidity of execution. Permit me to recapitulate, amplify and discuss the method I have already suggested for hand-made concrete:

First: An ample, tight and solid plank flooring upon which to operate. In work calling for large quantities this platform should be large enough to permit the mixing of two batches at once, so that one can be mixing while the other is being wheeled off.

Second: Spread the sand in a thin level bed; upon this spread similarly the cement and mix thoroughly, dry, with square-ended shovels. This is best done by placing a man at each corner, four in all, turning over first outward and then back again, passing the shovel down to the very bottom of the bed. No number of turnings specified, but reasonable uniformity of color and absence of streaks exacted. The mass to be left in a level bed.

Third: Upon this bed of dry mortar spread the stones evenly, they having been previously well wetted. You will remark that at this point I am at variance with most of your correspondents, who wet the sand and cement before adding the stone. I used to have this done, but happening once upon some work where the concrete was going in first rate shape with the stones placed on the dry mortar, I became convinced that this was an improvement on my own way, and have since adopted it, by preference. When the sand and cement are wet, made into mortar, in fact before adding the stone, a very sloppy state of affairs ensues, when the stone are dumped into the porridge. The men engaged in the work are wading in mortar, and quantities are adhering to their boots and whatever receptacles, barrels, boxes or barrows the stone is contained in. Moreover, time is lost without com-

pensating advantage by one extra manipulation, that of mixing the water with the sand and cement.

Fourth: The stone being spread, as above, throw a quantity of water, greater or less according to circumstances, upon the stones. This water percolates through the mass, down to the sand and cements, wetting them more regularly and evenly than by the other way, and absolutely without splashing. I think this feature will recommend itself to all practicians. You will note that the stone, being previously saturated, or nearly so, permit the water to pass freely through them down to the dry mortar.

Fifth: Having now secured nine points in the game, it only remains to turn the mass over, preferably by a man at each corner, outward and backward, letting the shovels scrape the planks, keeping the bed flat and level, and adding any additional amount of water that may be required. Working this way, with the platform near the point of deposition of the concrete, you ought to get in 2 cu. yds. of concrete per day of 10 hours, per man engaged on the work, all told.

Dosing the water, by adding so many measured buckets, accurately filled, would take a great deal of time, and would not, I think, secure a uniform result even if such result were desired. Even with exact measured quantities of water different batches will work some drier and some wetter than others, and in a foundation pit where there is frequently more or less water, or at least moisture, the degree of wetness of the concrete requires to be changed frequently, according to the nature of the bottom. A careful watch must be kept upon how the concrete is showing up in the work, and the consistency varied accordingly.

As to measuring: When cement is furnished in barrels, I believe the best and quickest way is to use the barrels themselves, heaping for the stone and sand, to compensate for the shake-down of the cement. The best, because the same measure is used for all; and the quickest, because as there will be always an abundance of barrels, one or more men can be kept steadily at work filling them up with stone and sand, so that measured quantities of each are constantly standing ready to be turned in. At present when cement is so generally furnished in bags, some other device may be preferable, but I think that bags, boxes and barrows are detrimental to accuracy of measurement.

In machine-made concrete, which is coming, most deservedly into common use when large quantities are required, I should doubt the expediency of an automatic feed of water. I have never used such a feed, so cannot speak from experience, but think that the same reasoning would apply as in the hand-made product except as to loss of time. When we know the degree of wetness which we desire, it is best to secure that degree by inspection rather than trust to the automatic working of a machine. A cubic foot of water seems to be wetter at one time than another, and an intelligent man placed where he can see the mixture coming out of the machine, can regulate the feed so as to keep a uniform product, or vary it, if ordered to do so.

I fully agree with what Mr. Hammon says of the use of boulders, or large stones, imbedded in the concrete. I believe that their use may be tolerated in certain cases in order to expedite the work, but I do not think their presence ever improves the concrete. One of the chief recommendations of concrete is its homogeneity and monolithic character. Both are impaired by the irregular introduction of a different material.

E. Sherman Gould.

Yonkers, N. Y., Jan. 18, 1904.

The Organization of Sections in Engineering Societies.

Sir: I have been much interested in reading the article under the above caption published in your issue of Jan. 14, principally as it is a subject which I have myself for some time desired to agitate. There is something certainly wrong with the national societies, or at least some of them, at the present time, when the principal, if not the only use of belonging to one seems to be the appendage of a series of letters after one's name. I am decidedly of the opinion that a good deal of shaking up and perhaps some "new blood" is necessary in order to reduce these bodies to some really useful and practical working conditions.

The catalogue of the American Society of Mechanical Engineers shows that there are in the State of Wisconsin 47 members, of whom 31 are located in the City of Milwaukee, and practically all within two or three hours' ride on the train—a nucleus for a very respectable local section, yet all of these members have no other opportunity of meeting each other or the other members of the society, except in the annual meeting, which is always held in New York, a thousand miles away, and the semi-annual meeting which is as often held in the East as the West. To these members the society house with its library and the intermediate meetings sometimes held there are practically useless.

In addition to these members of the society there are in this vicinity scores of other engineers or persons engaged in enterprises in such a way as to make such a section of sufficient interest to them, while a mere local society would not be.

I cannot see why American societies should not follow the plan generally laid down by one of their number, the Electrical Engineers, and found so successful, even if this example were necessary in view of that of many years standing of the Verein Deutscher Ingenieure, whose whole existence may be said to be one of sections.

In addition to this I might cite the Association of Engineering Societies which is principally a society formed by the union of several independent societies, in which each member receives the transactions of all, which transactions contain many valuable papers. I may also mention with respect to the last-named societies, that while their membership is actually worth more and gives more to their members, the membership expenses are actually less than they are in the American national societies.

There is still another source of dissatisfaction with regard to the management of the American Society of Mechanical Engineers, to wit: the fact that its members principally get their information about its transactions through the technical journals, as the transactions themselves are not published until they have passed into "ancient history." At the present writing I have not yet received my copy of Vol. 24, which contains the papers read and discussed in December, 1902. It goes without saying that people, as a rule, are not interested in what transpired so long ago, and when they get the morocco-bound volume will stow it away in some safe place on their shelves without giving it further attention.

It is objected that the delay in publishing is caused by the participants in the discussion who may be absent on professional journeys, or in Europe, or on a vacation, and refuse to look over and re-submit their remarks until returning; so in this way a single man may delay the publishing of a whole volume of papers for a month or two.

It would seem to the writer a very simple process to limit the time for revising discussions in the same way as this is done in other societies, to the end of increasing the value of the publication to the members and instilling some life into the society.

Another point of much interest is what you call the unique departure of the Canadian Society of Civil Engineers, which has obtained a practical monopoly of the engineering profession in the Province of Quebec. The evident corollary to such monopoly is the renunciation of choice on the part of the membership in the selection of new members, as all must simply pass an examination in order to obtain admission; but is not this after all the preferable procedure? It seems to me that such should be the case with any truly national society, to wit: that the requirements should be definite, and not depend merely on the whims of the existing members. In any balloting for new members it may be said that 99% of the balloting is merely formal in any case, as the proposed new members are not generally known to the rest of the membership.

It is evident that by the system of admission into the Canadian society any one can obtain membership who is worthy, while on the other hand, those who are not worthy, or are not, properly speaking, engineers cannot obtain membership as such, hence the membership in such a society means really much more than that in one where the members are not so qualified, but what is more important is the limitation of practicing engineers to competent persons, in the same way as membership in the medical and legal professions are now limited by law. When we consider that on the work of the engineer often depends the lives of hundreds or even thousands of people, does it not seem time that some such restriction by law were enacted?

It may be objected that the obtaining of a local monopoly by any engineering society, national or other, would be practically impossible in this country; a proposition which may be true, and yet steps may be taken in that direction without encountering this difficulty. For example, laws may be passed similar to the Quebec law requiring all those practicing as engineers to show their competency before an examining board and imposing penalties for non-compliance with the law. This, I understand, is the law in France, Germany and other European countries, and it appears to me a highly salutary one.

Aside from this, the national societies may themselves establish a rigid standard of competency as a prerequisite to membership, by subjecting candidates to an examination before a suitable board or committee, as I understand is done in some of the British societies. This might, it is true, be more exacting upon entering members than the current status of the profession in this country permits; yet I think it is time that some such standard should be established, to the end that membership may really be a mark of distinction and merit.

George W. Colles.

Milwaukee, Jan. 20, 1904.

"The New Epoch" and Co-operation Among Engineers.

Sir: The magnificent supplement to Mr. Carnegie's original offer in which he proposes to give one and one-half million dollars for a Union Engineering House in New York city provided all the societies join in accepting the gift, makes the action of the American Society of Civil Engineers upon this matter of immediate consequence to every member of the engineering profession.

In the conferences which the various committees have held during the past half year there has been a continual and successful endeavor to so shape plans and organization as to make them acceptable to the representatives of the American Society of Civil Engineers; and the representatives of that society have stated that every point which has been brought up has been satisfactorily met by the other members of the committee. In other words, the details have been adjusting themselves quite satisfactorily and the whole matter now rests on its general merits. I regard it as highly desirable that the whole subject should be presented through your columns along these lines, i. e., those which would make the proposed Union Engineering building an example of breadth and brotherhood in the American engineering profession.

I have just read with much interest the late Mr. George S. Morison's book, "The New Epoch." It was Mr. Morison, by the way, who drafted the cablegram at the meeting of the boards of directors of the several societies in the spring, which was the first communication from the societies to Mr. Carnegie. Mr. Morison's book is a noble and inspiring work. It not only puts the work of the engineer upon a higher plane, but it makes the introduction of the engineer the opening of a new epoch in civilization. What a commentary between such ideas as he has expressed and the actual ideas of American engineers it would be if American engineers should refuse to co-operate in the present enterprise! Very truly yours,

Chas. F. Scott.

Box 911, Pittsburg, Pa., Jan. 22, 1904.

A Proposed Vertical Division of the Union Engineering House.

Sir: I send you herewith copy of a letter sent by me to the Board of Direction of the American Society of Civil Engineers on June 19 last.

Considering the action of the society taken on Jan. 20, 1904, it would appear that no consideration whatever has been given by the societies to an arrangement of the new building which would preserve the major part of the ownership and affairs of each as intact as to-day. If such consideration has been given, it has not been made public.

It does not seem that the fundamental ideas necessary for the acceptance of this gift have been worked out to proper termination by the method suggested. It would be entirely feasible to participate in an honorable way in the gift proposed by Mr. Carnegie without in any manner jeopardizing the individual or future progress of any of the societies or the Engineers' Club. It is to be hoped before this subject is dropped by adverse vote, or even if it is dropped by adverse vote, that it may receive further consideration and be brought to a reasonable conclusion.

If you see your way clear I would be glad to have you publish this correspondence. Yours very truly,

Geo. B. Francis, Civil Engineer.

8 Bridge St., New York City, Jan. 21, 1904.

(The letter enclosed is printed below.—Ed.)

Board of Direction, American Society of Civil Engineers,
220 West 57th St., New York.

Gentlemen: The following suggestions were not made by the undersigned at the annual convention of the society in Asheville for the reason that it seemed better to place them before the Board of Direction in the form of a letter, than to take up the time of the convention.

Regarding the proposed engineering building, it would appear to me that the Am. Soc. C. E. should take such course as will maintain every interest of the society as nearly intact as possible, namely, its ownership of land, buildings, library, etc., etc. To this end it is suggested that it is wholly feasible to join in a general engineering building structure (providing proper land and also acquiescence on the part of Mr. Carnegie may be obtained) without in any great degree changing from definite ownership as now enjoyed by the society to a joint undivided ownership as seems proposed. This can be done, first, by having each of the societies own the fee in the land which it is proposed they shall occupy; second, having the general building divided vertically and so designed that the part devoted to each society may also be its property upon the land which it owns, and yet be a part of an architectural whole.

It may not be possible to do this on the piece of land already selected, but it does not seem to me the project is so far advanced that a new piece of land for such ownership cannot be obtained upon which such a structure could be designed.

The joint ownership and operation can then be restricted to a proper arrangement of rooms for auditorium purposes and for heating and perhaps lighting. Such a scheme properly carried out would bring the societies together into an engineering building, give all the benefits of contact of one society with another and leave each society wholly free as regards the major part of its property and the management of the same.

In this connection the action of one society could not

seriously affect or involve the affairs of another society. In such a building as a whole the division walls could be so arranged that all the private purposes, aside from joint auditorium and heating, would be carried out in as individual a manner as at present. This would also permit of one society owning more property than another if it so chose to do; for instance, the American Society of Civil Engineers might own a larger ground area and building than the Institute of Mining Engineers. Neither would thus involve the affairs of technical societies with those of the Engineers' Club, while they could all be together in one locality as a joint engineering headquarters, which appears to be the meaning and intent of Mr. Carnegie's gift.

Yours very truly,
Geo. B. Francis, Civil Engineer.

June 19, 1903.

The American Society of Civil Engineers and Mr. Carnegie's Proposition.

Sir: As a momentous question is now before the American Society of Civil Engineers, which question is shortly to be acted upon and decided by the letter ballot of its members, I earnestly beg space for the expression of my own very positive convictions on the subject.

I was a deeply interested auditor of the debate which occupied the greater part of the session at our late annual meeting, held in Carnegie Hall because our own new house, designed for the purpose of affording ample space for all uses of the society, and not yet wholly paid for, was already inadequate for a meeting of five or six hundred members, combined with a luncheon for the same. This fact of itself constituted an object lesson which must have sunk deeply into the minds of those present, coupled as it was by finding, on adjourning to our own house for lunch that the cloak room facilities fell so far short of the requirements, that members were invited to descend to the basement and hang their garments at random, on unchecked hooks. Also, the printed programs announced that none but members might partake of the lunch, indicating that we had reached the point when the limited capacity of our new house did not permit us to extend its hospitality to invited guests. I mention these facts at the outset to show that at the present writing our new and not yet paid for home is inadequate to our needs, and that soon additional and large pecuniary obligations must be incurred to avoid overflow meetings in outside halls.

On reading over the list of argumets, for and against, set forth at the meeting and republished in your issue of yesterday, one fact arrests attention: The arguments for the acceptance of Mr. Carnegie's offer are plain, business-like and practical, while those against acceptance are for the most part vague and sentimental. We naturally ask ourselves what are the ends and aims of the American Society of Civil Engineers, and why was it instituted? I do not believe that the purpose of its founders was to constitute a mutual admiration society, spending its time in complacent contemplation of its owu superiority. I believe it was intended to forward the practical object of advancing the science of engineering in all its branches in the United States of America by bringing together for mutual benefit and improvement those engaged in the practice of the profession. Since the organization of our society, which embraces all branches, other more special societies have sprung upwhich numberamong their members many of the leading and world-known names in their several branches. The proposition now is that all these societies, not one of which is entitled to treat the others with contempt, shall, while preserving their identity, be brought together under one roof, instead of being separately housed. Personally, I should hail the opportunity of thus becoming better acquainted with my professional peers in the other societies. I do not in the least fear that I should lower my technical standing by closer contact with them, rather the contrary. If I do not learn more from them than they do from me, it will be because I am slower of apprehension than they. As a member of our society I repel with scorn the apprehension that she will go under if placed alongside of others; rivals if you choose. If she cannot hold her own and show a lead, let her fall back and give way to others with more self-confidence and initiative.

But are these other organizations so distinct and separate from ours as we seem to take for granted that they are? It would be useful to know how many of our own members are also members of the other bodies. If housed together under one roof but in separate apartments, many would find themselves entitled to the run of the whole establishment, to "Les grandes et petites entrees" in virtue of a common affiliation, and I believe that our own membership would be largely increased by this close physical contact. As far as "absorption" goes (let me whisper in your ear) I believe it is the other fellows who should lie awake at night.

I might spin out this letter indefinitely; I might call attention to the fact that the proposition seems to be, one million and a half of dollars with the Am. Soc. C. E. and one million without her, and ask where we would be in the latter case, in the eyes of a world that judges—as alone it can judge—of the relative importance of things by their material appearance. I will not dwell on this point; but will conclude by presenting what seems to me to be the plain business side of the proposition—the dollars and cents side which as good engineers we are bound to keep always in view: Our present plant is inadequate to carry on our increasing business. Shall we enlarge it by assessment on our membership, resident and non-resident, or let Mr. Carnegie do the financing?

E. Sherman Gould, M. Am. Soc. C. E.

Yonkers, N. Y., Jan. 22, 1904.

Notes and Queries.

Mr. F. M. Norris, Mayor of Mason City, Ia., wishes to know where he can secure a copy of an ordinance fully protecting the interests of a municipality, requiring that all telephone, telegraph and other electric wires be placed underground. Perhaps some of our readers can give him the names of cities which have enacted such ordinances.

In "The Municipal Year Book" for 1902 it is stated under each municipality of 8,000 population and upward what wires, if any, are underground, while one column of a table on municipal ownership, in the introduction, also states whether or not the wires in each city are underground. The table in question is arranged in order of population, least to greatest, and states the ownership of water-works, sewers, electric lights, gas works, street railways, telephones, central heating stations and ferries, and underground wires in each of the 1,524 cities and towns in the "Year Book." At least 232 cities and towns had some wires underground early in 1902, but in most cases telephone wires, only, had been so placed.

MAKING CEMENT ROADWAYS IN RICHMOND, IND.

By H. L. Weber.*

Some time ago a reader of Engineering News asked the question, "Is cement used to make roadways?" I take pleasure in answering this question in the affirmative, and will add something about how we build cement roadways.

The street or alley, as the case may be, is subgraded to a depth of 12 ins. below the finished grade. The subgrade is tiled, if the nature of the ground is such that tiling is necessary. These tile are 3-in. common drain tile placed, say, 6 ins. below the subgrade.

Upon the subgrade we place 4 to 6 ins. of gravel or crushed stone, whichever may be the cheapest, and roll or ram to a uniform grade 6 ins. below the finished street. Upon this foundation is placed a layer of concrete 5 ins. thick after it has been rammed to place. I find wet concrete, machine-made, gives best results and requires about 10% less cement. The "mix" we use for concrete is 1 part best American Portland cement, or any other Portland cement equally good, and 8 parts gravel, in which there are about 3 parts sand. We also use 1 cement, 5 fine gravel and 3 crushed stone. Immediately after the concrete is rammed to place, an inch top finish is placed upon it, composed of 1 part cement, 1 part stone screenings and 1 part sand.

The top finish is put on very soft and thoroughly troweled to insure contact, then smoothed off with a template made to conform to the true crown or cross-section of the street. When sufficiently hard, this is troweled with a steel trowel, and lastly "raised," as we term it, with a wood or cork float.

This gives us a smooth surface, but a surface that does not wear glassy and slick, and one that does not get slippery in wet or winter weather; that is, any more so than other kinds of smooth-surface street, and, as we have further found by our experience, no more so than our macadam streets.

Our sidewalks are made in the same manner. When the sidewalk extends to the curb we make the outside edge next the street 8 to 10 ins. thick, bevel the outside edge, finish the upper corner with a 1-in. radius and bevel to form the curb. This gives us the best possible curb at a cost, over and above that of the walk, of about 15 cts. per linear foot. In this locality where crushed stone costs $1.25 per cu. yd. delivered on the street; the gravel, containing the sand, 75 cts. per cu. yd.; cement, $2.25 per bbl.; common labor, 16½ cts. per hour; cement finisher, 40 cts. per hour; we pave streets for about 16 cts. per sq. ft.; street alone without curb, $1.50 per sq. yd.; walk, 14 cts. per sq. ft.

*City Civil Engineer, Richmond, Ind.

FIG. 1. PAVING N. 7TH STREET, RICHMOND, IND., WITH CEMENT.
Note: The space in the center was left for a street railway track.

FIG. 2. A CEMENT STREET, CEMENT CURB AND CEMENT SIDEWALK, ELM PLACE, RICHMOND, IND.

Our streets and alleys are subjected to the ordinary heavy traffic and are standing up well under it.

ANNUAL MEETING OF THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.

The American Society of Heating and Ventilating Engineers celebrated its tenth birthday with an active and well-attended meeting, held at New York City on Jan. 19, 20 and 21, 1904. Some 150 members and guests were registered, an excellent representation for a total membership of little over 200. The five sessions of the meeting were held, as usual, at the house of the American Society of Mechanical Engineers, 12 West 31st St., New York. Four of the sessions were devoted entirely to the discussion of professional papers and special topics on matters connected with heating or ventilation. The latter, i. e., ventilation, was much in the background, however; heating occupied most of the available time and thoughts, which is not unnatural when it is considered that vastly more money and coal goes into heating than into ventilation.

A noteworthy matter relating to the affairs of the society as a whole was contained in the report of the Board of Governors. It will be recalled that at present much attention is being given by engineering societies of all kinds to the local-section idea. The proposition to promote local sections of this society came before the governors during the past year. They report as follows:

According to resolution at the last annual and summer meetings, your Board of Governors have carefully considered the advisability of organizing local chapters of the society in different sections of our country. After due consideration, it was decided that on account of our limited membership and the few points where sufficient numbers could be got together to make it a success, we report against the question of local chapters at this time.

In view of the fact that the society holds only two meetings a year, with a total of say a dozen papers per year, the purpose of local sections is not obvious. Moreover, the good attendance ratio at this meeting proves that the society is not yet so widely scattered that it need decentralize.

Another matter of general interest was reported by the Board of Governors. A letter-ballot vote on the metric system was taken during the past year among the members of the society, with the following result:

Voting membership		168
Average votes cast		80
In favor of the adoption of the metric system of weights and measures as the legal standard of the United States	34	
Against		45
In favor of adoption of metric system in departments of Federal Government	37	
Against		42
In favor of legislation which would promote the adoption of the metric system	41	
Against		39

The subject also came up for discussion during the meeting through a paper "The Metric System," presented by Mr. C. F. Hauss, of Antwerp, Belgium. The discussion brought out nothing new or interesting, except that there were a few ardent advocates of substituting the metric system for our present weights and measures, and others as firmly opposed to such a step.

The election of officers and minor current business were the only other matters, beside the professional program, that came before the meeting. The following officers were elected for the coming year: President, Mr. Andrew Harvey, of Detroit, Mich.; Vice-Presidents, Mr. John Gormly, and Mr. R. C. Clarkson, both of Philadelphia, Pa.; Secretary, Mr. W. M. Mackay, of New York City; Treasurer, Mr. U. G. Scollay, of New York City; Governors, Prof. R. C. Carpenter, of Ithaca, N. Y.; Mr. A. E. Kenrick, of Brookline, Mass.; Mr. C. B. J. Snyder, of New York City; Mr. H. D. Crane, of Cincinnati, O.; and Mr. J. J. Blackmore, of New York City. It is probable that the summer meeting of 1904 will be held in Detroit, Mich.

The professional work of the meeting, both papers and discussions, is briefly reviewed in the following:

RED LEAD OR OIL VS. METALLIC JOINTS IN PIPE WORK.

A topical discussion on the question, "In making screwed joints is it better to use some compound or make them up iron to iron with no compound?" gave several bits of information as to why it is necessary or desirable to use some compound in pipe joints. Pipe fittings and the threads on the pipe ends are not always uniform, even when coming from the same maker. They usually lie around and accumulate dirt and rust before being used, so that they go together hard. Threads do not fit precisely, and fittings may leak, particularly under high pressures; also threads not served with compound tend to cut when screwed together. After the joint is in service, the threads may rust together and make it difficult to get them apart later. Red lead was formerly much used as a pipe compound, to lubricate, preserve, and make a tight joint. It was stated that nowadays most steamfitting is done without red lead. Graphite and oil, mixed to the consistency of table oil, is often used nowadays, and is efficient in lubricating as well as in making a tight joint. The compound should always be put on the male screw, and not daubed into the female end, to prevent its being crowded to the rear of the joint and reducing the clear opening of the pipe. One member stated that it was necessary to constantly watch over workmen to keep them from putting the compound into the female end or putting it on too thick; a thin coating is sufficient to get the desired effect. A special case is that of oiling systems, where oil is carried through pipes. Mr. H. D. Crane (Cincinnati) found that oil, graphite or red lead will not make an oil-tight joint, but seem to be washed out. He uses black asphaltum, about as thick as melted butter, and finds this successful.

As to the non-uniformity of threads tapped in fittings, it was remarked by Mr. A. A. Cary (New York) that in machine tapping the tap should be held loosely in the chuck, or in a flexible connection, otherwise the unavoidable eccentricity will produce a hole larger than the tap. Threads are often tapered to allow for variations in diameter. It was suggested that a standard length for threads on pipes and fittings should be formulated.

VENTILATION IN CONNECTION WITH DWELLING-HOUSE HEATING.

A "topical" question, entitled "Has the need been demonstrated of some method of ventilation in connection with accepted systems of heating?" was found to refer to hot-air heating in dwelling houses. It is often found difficult to get heat into a room in such a house, for the reason that doors and windows are so tight that the hot air cannot enter the closed room. In such cases an uptake flue should be provided; an open grate answers the same purpose. Most houses, however, have sufficient leakage around doors and windows to render unnecessary any ventilation having the purpose only to facilitate the heating. A special device to facilitate the flow of air in air-furnace systems was described by Mr. E. S. Berry (Syracuse, N. Y.). It is simply an electric fan, say 12 ins., in the cold-air box to the furnace, and a wall switch to start or stop the fan. When the house is to be heated rapidly, the fan is run for a time and a large volume of air thereby pumped through the furnace.

Ventilation *per se* is often quite necessary in dwelling houses, especially in those of more substantial build, and in city apartments. Several styles of window ventilator which can be easily applied were described. The circulation of air by floor registers to the cold-air duct of the furnace does not meet the needs of ventilation, although it provides for the ready entrance of the heated air into rooms. In the case of apartment dwellings, Mr. A. Reck (Copenhagen, Denmark) recommended that each apartment have an uptake or draft ventilator, to remove the impure air, and that the halls and staircases be kept ventilated and full of fresh air, to act as air supply to the different apartments. If this is not done, the uptake in the apartments serves merely to draw in the bad air from the stairways and corridors.

The main difficulty in providing ventilation for dwelling houses is that architects will not make room for the vent flues in the walls; this fact was testified to by several. The public also has little appreciation of ventilation for dwelling houses, and seems to believe that drafts are more dangerous than bad air.

HOT-WATER HEATING WITH ACCELERATED CIRCULATION.

Mr. Anders B. Reck, of Copenhagen, Denmark, in a paper entitled "Hot-Water Heating Apparatus in Schioldann Institution, Copenhagen, Denmark," described an ingenious method of accelerating the circulation in hot-water heating systems, a method which makes it feasible to use smaller pipes for the hot-water distribution and gives much more rapid heating-up of the system than in ordinary installations. This special method, originated by Mr. Reck, has been applied in a large number of installations in Europe, but has not yet been introduced in America.

A heating installation embodying the Reck method is shown in diagram in the accompanying Fig. 1. The water circulation system consists of the main S, the expansion tank E, the distributing main T, and the down-takes L, to which the radiators O are connected as shown; from the down-takes the cool water flows back through pipe R to the heater B, which is the source of heat for the water system. Steam supplied by a low-pressure boiler A is used to heat the water in B; exhaust steam from an engine may be used, if convenient. From the steam space of the heater a pipe, D, is led up to the attic, to a so-called circulator, which is inserted in the supply pipe a few feet below the expansion tank. The circulator is a small water chamber from which a vertical pipe leads up into the expansion tank; the steam pipe D ends in a perforated end in the circulator chamber. When steam from pipe D passes into the circulator chamber, it rapidly heats the water up to near the boiling point; the highly-heated water, passing up through the pipe to the expansion tank, disengages steam bubbles, which rise up into the air space of the tank. Evidently, while a column of water full of steam bubbles is contained in the pipe between circulator and tank, it is lighter than the solid water in pipe T; therefore, a corresponding difference of head will act to accelerate the circulation of the water in the system. Generally, when the circulator C is working, the pipe above the circulator contains, roughly, half water and half steam, and the accelerating difference of head will then be half the length of this pipe. Thus, if the circulator is 8 ft. below the expansion tank, a difference of head amounting to 4 ft. would be produced.

The steam which collects in the top of tank E is led down by pipe M to a small surface condenser, F, interpolated in the supply pipe S. From here it drips back through pipe G to the boiler.

With the relatively large difference of head produced by the circulator, a high velocity of flow may be obtained in the water pipes and very small pipes may, therefore, be used. Further, since the working temperature of the water after passing the circulator is very near the boiling point, the heating surface required is smaller than with other systems in which such high temperatures cannot be reached.

The system has some accessories not shown on our diagram. An automatic air valve is usually attached to the casing of condenser F to free the system from air accumulation. The boiler A is fitted with a pressure regulator, whose weight has two positions: in the outer position, it allows the steam pressure to rise high enough to overcome the head of water on circulator C, and thus allows steam to enter the circulator and start its action; in the other position it keeps the boiler pressure down to such a point that the circulator remains out of action. The usual practice is to raise the pressure every morning for an hour or two, thereby rapidly heating up the system (and therefore the building) by the increased velocity of circulation in the water pipes. When the building is well heated up, the regulator is set for the lower pressure and the system is run as an ordinary hot-water system the rest of the day. In very cold weather, of course, the circulator may be kept in operation as long as desired. The circulator is said to be entirely noiseless in operation.

It may be noted that the distribution piping L is usually installed on the two-pipe plan. The one-pipe system is shown in the diagram because it was used in the sample installation described in the paper.

Much interest in the new system was manifested by the discussion which followed the reading of the paper. Most of the discussion was composed of questions by the members, and further explanation of the system by the author. An interesting point raised was the application of the system to high buildings. Mr. Reck recommended that high buildings be divided into sets of say five floors each, and a separate piping system, with separate heater B, circulator C and expansion tank E, be installed for each set of floors. Then a single central boiler or other steam supply could be used to supply steam to the different heaters and circulators.

HOT-AIR HEATING.

Two papers on hot-air furnace work were presented. Mr. C. E. Oldacre (Philadelphia, Pa.) read a paper on "The Battery System of Warm-Air Heating." The essential part of the installation described by him is the use of two smaller furnaces in place of one large one. The casings are separate up to a common hood on top. The arrangement secures a greater ratio of heating surface to grate surface; in a typical case it gives a ratio of 40 to 1 in place of 30 to 1 which the larger single furnace gives.

The objection urged against this plan in discussion is that the smaller furnaces do not hold their fire so well; but with the larger furnace it is hard to keep the heat down in mild weather. The latter argument is not important; the former was disputed to some extent, a case being cited where an 18-in. grate with fire 15 to 17 ins. deep held its fire from Saturday afternoon to Monday morning, without any attention, regularly for a number of years.

Mr. Geo. M. Aylsworth, of Collingwood, Conn., read a paper entitled "Test of a Hot-Air Heating Apparatus Using Radiators Instead of Registers." This paper gave the temperatures obtained in a trial run of eight days on a dwelling-house air-heating system fitted with sheet-iron radiators as described by the author before this society at the last summer meeting (see Engineering News of July 30, 1903.) The radiating surface installed was about 35% less than is the practice in hot-water systems, yet satisfactory temperatures were obtained in spite of low outdoor temperatures.

In discussion it was pointed out that coal records are yet needed before a conclusion can be formed as to the economy of the system. The system was considered very promising; the objection that it gives no ventilation effect was not considered a serious one for dwelling-house work, particularly as the ventilating value of the ordinary hot-air system is rather doubtful. The air piping used in the radiator system is much smaller than where registers are used. The question of danger of overheating was raised. Mr. W. F. Wolfe (New York City) thought that there was not much risk of damage to the furnace from overheating, though others cited the fact that ordinary furnace firepots often crack from overheating, especially where the circulation is restricted, as below the fire-door. It was stated that in ordinary hot-air systems a temperature of 300° is sometimes reached at the register, and that higher temperatures might occur in the radiator system. The use of an automatic draft regulator was suggested to prevent such overheating and risk of fire.

THE NEED OF MOISTURE IN HOUSES.

Closely related to hot-air furnace working was a paper by Prof. R. C. Carpenter (Ithaca, N. Y.) on "The Necessity of Moisture in Heated Houses." This paper gave about the same citations on this subject as were given in the Engineering Literature supplement to Engineering News recently (Dec. 10, 1903). A passage in the paper is worth noting, because it calls attention to the fact that the moisture question has to do with steam and hot-water systems as well as with air systems:

> I am of the opinion that popularly the hot-air furnace is credited with removing more moisture from the air which it warms than is the case with the steam or hot-water radiator. From the effects, however, which I have frequently observed as to the drying out of furniture and the shrinkage of woodwork generally, I am inclined to believe that this opinion is somewhat in error, and I think that accurate measurements will fail to prove the hot-air furnace to be a greater sinner in this respect than our other systems of heating.

Professor Carpenter expressed no opinion on whether the much greater dryness of air in heated houses over the outdoor air is good or bad for the health. The water pan of hot-air furnaces was quite generally condemned by those present, as being inefficient in moistening the air, being dirty, and impeding circulation in the furnace casing. Some thought that the firepot had a tendency to crack near the water pan from overheating, but this was disputed. Good furnaces, it was stated, do not nowadays have the water pan located under the fire-door, but at the side. Mr. C. E. Oldacre (Philadelphia, Pa.) objected to water pans, claiming they are dirty and inefficient. They never add more than 2 or 3% to the relative humidity. He has tried special means for increasing the humidity in a hot-air system, by placing water pans in the registers, but succeeded in adding only 5% to the humidity. For full discussion of humidity in houses he referred to a recent German work, Wolpert's "Theorie und Praxis der Heizung und Ventilation." Mr. H. J. Barron (New York City) considered that the question of humidity was important only in relation to furniture and, in libraries, book bindings.

Mr. Charles F. Hauss (Antwerp, Belgium), in a paper entitled, "To Figure Heating Work Accurately," presented a table of radiation losses from various kinds of surfaces, as brick walls, windows, floors, etc., according to the practice of an engineer of Hamburg, Germany, Mr. A. Block. The table is in convenient form for calculations, since it gives the heat lost per hour, in B. T. U., from various kinds of surfaces for various differences in temperature on the two sides of the surface. The paper gave some figures as to the heat radiating capacity of radiators and furnace walls. In hot-air furnaces, the furnace walls transmit 450-550 B. T. U. per sq. ft. per hour if the furnace has much extended surface, and 750-850 B. T. U. if the surface is smooth, the air temperatures at the register being 100° to 150° F. In a room heated to 70° F., steam radiators, at 1½ lbs. pressure, will radiate per square foot of surface, from 225 B. T. U. per hour for four-column radiators, up to 300 B. T. U. for single-column radiators. Boilers will transmit through their heating surface about 2,000 to 4,000 B. T. U. if fired with coal, and 4,000 to 5,000 B. T. U. if fired with coke; the lower values apply to sectional boilers, the higher values to round one-piece firepots.

Professor W. Kent (Syracuse, N. Y.) stated that the figures of this table agree closely with American practice, as given in Carpenter's "Heating and Ventilation." They are all based on experimental work nearly 100 years old, and new experiments on heat transmission are badly needed. There was some discussion as to the amount of heat transmitted through the heating surface of hot-air furnaces. Mr. J. J. Kinealy (Boston, Mass.) gave the figure 600-700 B.T.U. per hour per square foot; others gave 700-750. It was generally agreed that hot-air systems provided with a blower give much higher transmission values, up to 2,000 B. T. U. per hour.

The following papers were also read at the meeting: "A Short History of Our Society," by Mr. S. A. Jellett (Philadelphia, Pa.), and "A Review of Some Heating Literature," by Mr. H. J. Barron (New York City). The paper on "The Metric System," by Mr. C. F. Hauss (Antwerp, Belgium), has already been mentioned. The discussion of the latter paper, in which Mr. J. J. Kinealy (Boston, Mass.) was the principal defender of our present system of measures, brought out testimony from Mr. A. B. Reck (Copenhagen, Denmark). Denmark has retained its old measures, and is not among the metric countries, because of its close relations with England. Naturally, with the contiguity of Denmark to the continent of Europe, the metric system must be used to some extent, and Mr. Reck is therefore fully as familiar with it as with the old system. Yet he declares that he can think and figure much more readily in the old system, and therefore prefers to use it. In scientific work, he says, it is no great work to translate from one system to another, so that it is not necessary on this account to adopt the metric system for everyday work, where the foot system is handier.

COMPULSORY VENTILATION.

The society has standing committees on Tests, Standards and Compulsory Legislation, respectively. Of their work during the past year we may note the progress (or lack of progress) made by the last-named committee. The legislation aimed at is for the provision of ventilation in buildings of various classes. Attempts have been made repeatedly to get different States to pass acts of this character, but so far without success. Pennsylvania and New York were tried during the past year, but without success. A ventilation bill is to be introduced in the New York State Legislature during the present session, to apply to cities of the third class and incorporated villages. Larger cities, of the first and second classes, in most cases already have some sort of municipal legislation covering the subject.

GREENHOUSE HEATING.

A "topical" discussion on whether hot-water greenhouse heating systems should preferably use large cast-iron or small wrought-iron pipe elicited some general opinions on grenhouse heating. Prof. R. C. Carpenter (Ithaca, N. Y.) reported that a temperature of — 21° F. had been experienced at Ithaca the preceding night (Jan. 18-19); one of the Cornell University greenhouses has hot-water heating with large pipes, and the large heat storage capacity of these pipes had kept the temperature up without requiring attention to the fire during the night. He stated that Prof. L. H. Bailey, of Cornell, considered this to be a decisive experience in favor of the large-pipe hot-water system for greenhouses. Hitherto the Cornell authorities have considered steam the best. The largest greenhouse there was equipped with steam heat as the result of a long-continued economy test of two greenhouses, one being fitted with steam, the other with hot water; the steam system came out ahead in coal economy by about 15 to 20%, although in a previous test, much shorter in duration, Professor Carpenter had found hot water to give superior economy.

Others expressed preference for 2-in. wrought-iron against 4-in. cast-iron pipes in hot-water greenhouse systems. Mr. W. M. Mackay (New York City), who took this position, considered the heat storage to depend upon boiler and firepot capacity rather than on size of pipe; that is, the total water in the system, and the volume of fire, are the determining factors. He believed that modern (small pipe) hot-water greenhouse systems are better than steam, and this in turn better than the old hot-water system with its large cast-iron pipes. Mr. H. J. Barron (New York City) and Mr. A. B. Reck (Copenhagen, Denmark) also expressed preference for hot water against steam, and small pipe against large pipe systems. Mr. A. Harvey (Detroit, Mich.) described a combination system which he has installed in a large 12-room greenhouse. The boiler room, under the central building, supplies steam to a coil at the far end of each room, and from this coil the water of condensation is led back through radiating coils and thence to the boiler. The system works very well and makes a quick regulation possible by varying the amount of steam supplied to the steam coil.

The other topics discussed during the meeting brought out little or no information of value. The discussion of the question, "Should it be considered the work of the society to secure and preserve records in detail of the different types of heating systems in different types of buildings?" indicated that there is a need for historical matter on heating and ventilation. The question of how and to what extent the society should work in this field was finally referred to the Board of Governors for consideration.

The society met at a dinner on the evening of Wednesday, Jan. 20, where the tenth anniversary was celebrated in numerous toasts. In the course of the dinner a loving cup was presented to the secretary, Mr. W. M. Mackay, in appreciation of his long service for the society.

ANNUAL CONVENTION OF THE ILLINOIS SOCIETY OF ENGINEERS AND SURVEYORS.

The nineteenth meeting of this Society was held at Champaign, Ill., Jan. 20, 21 and 22, the place of meeting being the Physics Hall of the Engineering Building of the University of Illinois, and the headquarters being at the Beardsley Hotel. The meeting was called to order at 2 p. m., Jan. 20, by the President, Mr. John W. Alvord, of Chicago.

and an address of welcome was delivered by Prof. I. O. Baker, head of the Civil Engineering Department, who outlined the work of the University and its engineering department.

Prof. N. C. Ricker, Dean of the College of Engineering, then presented an address on the development and work of this college, and specially referred to the rapid increase in the number of its students. The engineering experiment station, which is to be established with a part of the appropriation made by the last legislature, will undertake scientific investigations in many lines. No separate building will be required, but it has been decided to build a new foundry, to enlarge the forge and machine shops, and to erect a new mechanical engineering laboratory. The erection of the buildings and construction of machines (mostly built to order) will require about a year. After describing the various investigational work now in progress, Dean Ricker earnestly requested the members of the Society (and those of other societies) to suggest problems for investigation, and intimated that the success of the new engineering experiment station will depend largely upon the good will and assistance of engineers in Illinois.

The President, Mr. Alvord, then delivered the annual address, which was none the less instructive and interesting for being written in a humorous vein.

The address was followed by a paper on "Municipally-Owned Water, Gas and Electric Light Works," by Mr. F. E. Herdman (Winnetka). This paper, which was read by the Secretary, was devoted mainly to a description of the methods adopted for the organization, construction and operation of municipal water, gas and electric light plants at Winnetka, which plants have proved a great success, financially and otherwise. In the discussion Mr. Alvord pointed out that the results were largely due to the capability and technical education of the man at the head of the enterprise, and Prof. Talbot stated that it was really remarkable how, without any special legislation or opportunities, the city had managed to put in and pay for such a fine plant.

CONCRETE WORK.

The remainder of this first session was devoted to a series of practical papers on concrete, which, with the discussion following them, indicated the great importance of and interest in this subject. Mr. L. Z. Jones (Galva, Ill.) presented a paper entitled "Concrete on the Farm," in which he showed in how many cases concrete could be substituted for wood with advantage and economy. Prof. I. O. Baker called attention to the growing increase in the use of concrete instead of timber within the past few years, and said he expected this to increase still more rapidly with the decline in price of cement and the rising prices of timber.

Mr. J. L. Clark (Momence) considered concrete very much better than ordinary stone masonry, and Mr. Malcolm (Champaign) mentioned several applications of concrete in farm work. Mr. Nicolet (La Salle) favored good tamping, and Mr. Alvord (Chicago) spoke of a compressed-air tamping machine.

A paper on "Concrete Foundations and Cement Filler for Brick Pavements" was then read by Mr. O. L. Gearheart, City Engineer of Champaign, who also presented a table of the strength and cost of concrete of different compositions. A matter of rather unusual interest considered in this paper was the strength afforded by the cement filler in brick paving. Beams $10\frac{1}{2} \times 24$ ins., and 4 ins. deep, built of bricks fastened together with cement, carried loads of 1,640 to 2,660 lbs. at the center. He suggested that it might be more economical to use the cement in this way than in a concrete foundation. In discussing this paper, Mr. Alvord remarked that concrete foundations under brick pavement are usually no better than macadam of indifferent quality; in nine cases out of ten where he had made investigations the concrete was not worthy of the name, owing either to carelessness, inefficiency or dishonesty. This applied to both natural and Portland cement concrete. Prof. Talbot also said that many pavements and pavement foundations show a combination of poor material, poor mixtures and poor workmanship. Other speakers referred to the necessity of a solid and well-rolled foundation under the concrete; and Prof. Baker remarked that the prime necessity was not so much a heavy roller as one that can be run both transversely and longitudinally of the street.

A paper on "The Effects of Manure on Masonry and Concrete" was read by Mr. L. A. Waterbury, giving the results of tests of briquettes made with and kept in clear water and the effluent liquid from manure. Mr. Jones (Galva), however, thought that the effect of this treatment would not be the same as that of hot fermenting manure placed on fresh concrete to prevent freezing. Prof. Baker referred to concrete structures on the Wabash Ry. which had been given a surface wash of a cream of cement and plaster of paris, which gave a finish like marble. He also advocated a slight crowning of concrete walls, and expressed the opinion that concrete made with stone is stronger than that made with gravel. Mr. Tratman (Associate Editor, Engineering News) pointed out that a recent paper by Mr. S. L. Newberry claimed a greater strength for gravel concrete.

At the evening session, Mr. F. C. Amsbary (Champaign) presented a paper on "The Water-Works of Champaign and Urbana," and was followed by Mr. H. M. Ely (Danville) with a paper on "The Danville Water-Works Dam," illustrated by lantern slides. A paper of special interest, on "Floods and Flood Protection Works at East St. Louis" was then read by Mr. J. F. Parr (East St. Louis). The report of the Committee on Architecture was read by Prof. N. C. Ricker (U. of Ill.), showing that 546 licenses for architects are now in force in Illinois. The report of the Committee on Mechanical Engineering was then presented, in which reference was made to a 5,000-HP. rotary engine for the St. Louis Exhibition. The last paper of the session was by Mr. O. F. Dubois (Peoria), on:

THE CITY PARK OF A MEDIUM SIZED TOWN.

Assume a 40-acre tract of ground, devoid of any natural beauty, rectangular in shape, located on the outskirts of an inland town having a population of 10,000. The first question would be the location of the entrances, and these would be defined by proximity of car lines and public streets. In the center of the park should be the pavilion or park house, facing the entrances. This pavilion would be the center of a semicircle of a radius equal to two-thirds of the distance to the nearest boundary fence, about 440 ft.; this to be the skeleton contour shore line of a park lake of about seven acres, with a depth of 4 to 5 ft. The two ends of this semicircle would be closed together at the pavilion by natural graceful curves, breaking the regularity of outline by small bays. One end of this lake area may be made picturesque by islands connected by foot bridges. Divide the grounds in the rear of the pavilion into two 10-acre squares; one of these to be used for open lawn and playgrounds, and the other for grove and close plantings. Connect these parts, and in some cases encircle them, by footwalks and drives of natural contours, running from the park gates and merging at the pavilion. The pavilion building, designed to have large covered balconies for shelter, must be made accessible for vehicles and foot people, and by boat landing from the lake. The basement will have lavatories and storage room for park implements and fuel. Near the pavilion should be the band house.

The principal park entrance should be the terminus of a parkway or boulevard to the city, having double driveways 30 ft. in width and bordered on the outside by evenly spaced, symmetrical trees. On the center lawn between the roads may be massed beds of flowers, in geometrical pattern; and at some future time groups of monumental statuary or a fountain may be added. Along similar lines the boulevard may be improved, adding 15-ft. side lawns to the drives and 8-ft. sidewalks; that is, if the parkway is not over six or seven blocks long. Beyond this length, one central driveway 50 ft. wide, and lawns 17 ft. each, with the 8-ft. sidewalks are preferable and in better proportion to the length. The profile of the roadways and their construction are determined by the kind of material to be used. The grade from the curb to the lot line is the one usually adopted, of 1-in. in 3 ft., and the grade of the sidewalk for the parkway, as well as the one of the public street, should follow the curb grade. We all know the ugly appearance of a 6-ft. sidewalk, perched on the lot grade with a 6 or 8-ft. grass plot, sloping down 3 or 4 ft. to the curb, and a roadway 38 or 40 ft. wide. A street width should be half roadway and the other half sidewalk and lawns.

ROAD IMPROVEMENTS.

The morning session on Jan. 21 was devoted entirely to papers and discussions on the road improvement question. Mr. H. G. Paddock first presented the report of the Committee on Roads and Pavements. This stated that "We will never have a general system of gravel roads until the State contributes a large percentage of the cost and regulates the construction." It also pointed out that in streets with railway tracks there are occasional failures owing to the fact that a proper foundation is not given to the ties, thus allowing the pavement over the ties to settle. Prof. I. O. Baker then gave an interesting address on "Illinois Engineers and Illinois Highways," in which he showed that the farmers and country people have a more active interest in the road question than is generally supposed, and he argued that in the matter of road improvement engineers should be willing to serve the public gratuitously, as doctors serve in matters connected with public health, or as lawyers serve in franchise and other public matters. We shall give an abstract of this paper in a later issue. The secretary then read a paper on "The Illinois Good Roads Commission," by Hon. D. W. Smith, Chairman of this commission, which was appointed last year by the Governor. This paper described the organization and work of the commission, the important relations of the roads to rural life and development, and then referred particularly to the necessity of drainage in connection with road construction and maintenance. This latter point was emphasized in the discussion. On motion of Prof. Baker, a committee was appointed to consider the work of the commission; and at a later session resolutions were adopted commending the work thus far accomplished, expressing the interest of the Society in the matter, and offering its co-operation.

A paper on "Present Practice in Stone Road Construction in Northern Illinois" was next read by Mr. L. A. Waterbury (U. of Ill.), and some extracts from this follow:

In Palmyra township, crushed stone (with the very fine material screened out) is laid to a depth of 10 ins. at the center and 6 ins. at the edges, which are protected by plowing a furrow and banking the earth against the stone with a grader. Fine screenings are then placed, and the road is rolled. The usual width is 20 ft., and the cost of finished road is $5 per lin. ft., or $1,000 per mile. Quarries are opened along the road, so that the average haul is about one mile. The rolling would have more effect if done while the road is being built, but the rolling of the finished road has the advantage of making a surface that will attract travel, instead of causing vehicles to use the dirt track until it becomes impassable.

In Buffalo township, where the roads are on hilly ground, the stone is usually placed in a trench, to protect the edges; but on level ground it is laid on the surface. The first layer is 8 ins. of coarse stone broken in place by hand, and increased to 12 ins. where the road is very bad in wet seasons. This is rolled with a 6-ton horse roller and covered with 3 ins. of crushed stone, well rolled. Then comes a 2-in. layer of finer stone and then some fine screenings, after which the road is again rolled. It should not be necessary, however, to use 14 ins. of stone, and it would be more economical to drain the ground, so that less material would suffice. The construction costs $1,700 to $1,800 per mile.

In Palmyra township, the roads are built by contract, this being considered the cheaper plan. Buffalo township builds its roads, for the reason that a large part of the labor is donated.

Three other papers on the road question were then read, as follows: "Road Construction in Massachusetts, New Jersey and Connecticut," by L. G. Parker (U. of Ill.); "The Road Laws of Illinois," by R. I. Webber (U. of Ill.); and "Recent Legislation on Roads in Several States," by E. E. R. Tratman (Engineering News). The session concluded with the report of the Committee on Surveying, by Mr. J. G. Mellulsh (Bloomington).

SEWERAGE AND DRAINAGE.

At the afternoon session Mr. C. G. Elliott (Washington, D. C.) presented a paper on "Drainage and Irrigation in the Middle West," from which we make the following extracts:

The features of the work which differ materially from eastern practice are as follows: 1, The necessity of dredging large and deep channels, in the absence of sufficient natural streams; 2, The use of larger drain tiles than were ever employed before for agricultural drainage; 3, The construction of extended systems on less grades than had previously been thought practicable, and a greater distance between individual lines of drains than had hitherto been practiced. It is to be regretted that no investigation of the run-off of lands has been made with reference to the effect due to changes in the surface by cultivation and improved drainage. These changes produce flood heights of quick rise and short duration.

The use of irrigation as an accessory to drainage in the middle west is commending itself to some of those who grow crops of high value which are peculiarly sensitive to deficiency of moisture, and experiments indicate that as a supplemental improvement irrigation may be employed in many instances with great profit. It is, however, contingent upon the high value of land and its in-

tensive cultivation near cities or where market facilities are good. Market gardeners and fruit growers find that when water can be obtained and applied within reasonable limits of expense, irrigation is profitable.

The next paper, by Mr. M. O. Leighton (Washington, D. C.), was on "The Work of the U. S. Geological Survey in Illinois." It outlined the geological investigation, the hydrographic work in regard to stream gagings and ground waters, and the hydro-economic investigations into the quality of waters, with special reference to industrial and domestic purposes.

A paper on "The Measurement of Flow in Sewers" was read by Prof. A. N. Talbot, and described the different methods employed in making such measurements. This was followed by a short paper on "The Purification of Sewage" by Mr. G. L. Sawyer (Chicago). The session was closed about 3.30 to give time for a tour of the engineering buildings and other points of interest at the University.

At the evening session Mr. J. L. Clark (Momence) presented the report of the Committee on Drainage, in which he referred to the work done towards reclaiming the great Kankakee marsh, which is very incomplete and should be done by one comprehensive system rather than by a multiplicity of individual systems. He considered it unsafe to use the average rainfall and run-off as a basis for determining the sizes of drains, and thought that the increase in price of crops would result in the use of much larger drains than have been or are now recommended. A paper on "The Hennepin Canal," by Mr. J. C. Long, U. S. Asst. Engr. (Princeton, Ill.), was read by the Secretary, and of this we shall give an abstract later. Mr. D. W. Mead followed with a highly interesting general address on "Some Recent Water-Works and Water Power Installations," which was illustrated by nearly 50 lantern slides of pumping and filter plants, machinery, etc. At the close of the session there was a "social hour" in the faculty rooms, enlivened by certain "yarns" from the professors and singing by the university glee club.

On Friday morning the session opened with a paper by Mr. D. H. Sawyer (Paris, Ill.) on "The Municipal Water-Works and Electric Light Plant of Paris, Ill." Following this, Mr. G. I. Herrick (Wheaton) described "Some Recent Inventions in Measuring Instruments." These included a special design of tape for measuring or laying out angles on the ground, and a combined pin and tape holder, fitted with a clamp for holding the tape. For use with the tape there is a tape case fitted with gearing, by which the tape is wound up much more rapidly than is ordinarily practicable. Mr. L. A. Waterbury (U. of Ill.) then read a paper on "The Economy and Accuracy of Various Methods of Leveling," from which we condense the following table:

	Cost.	Accuracy.	Cost plus accuracy.
Standard	$100	100	100
Engineer's level	50	90	45
Hand level	46	96	45 or 52
Stadia	43 or 50	87	29
Barometer	28	81	62

OFFICERS AND REPORTS.

The election of officers resulted as follows: President, John W. Alvord. Chicago; Vice-President, C. H. Nicolet, La Salle; Trustees, D. W. Mead, J. G. Melluish, W. M. Hay, J. E. Kemp; Secretary and Treasurer, E. E. R. Tratman, Chicago. It was voted to hold the next meeting at Chicago, in January, 1905. The report of the Secretary showed a very satisfactory condition of affairs, the Society having now 141 members and a cash balance of $206, with no debts and $124 due to the Society.

On Jan. 22 there was an excursion to Danville, by invitation of Mr. F. W. Butterworth, General Manager of the Western Brick Co. A special car was provided on the C., C., C. & St. L. Ry., and after a dinner at the Plaza Hotel the party boarded a special car provided by Mr. L. E. Fischer, General Manager of the Urbana, Champaign & Danville Electric Ry. They first visited the Danville water-works and the new water filtration plant, designed by Mr. D. W. Mead, who explained the features of the construction and operation. They then went to the paving and building brick works of the Western Brick Co. These works were described in full in our issue of Jan. 14, and in a later issue we shall publish a description of the Danville water filtration plant.

FIG. 1. A LARGE BLAST AT MARIVELES QUARRIES, MANILA HARBOR.

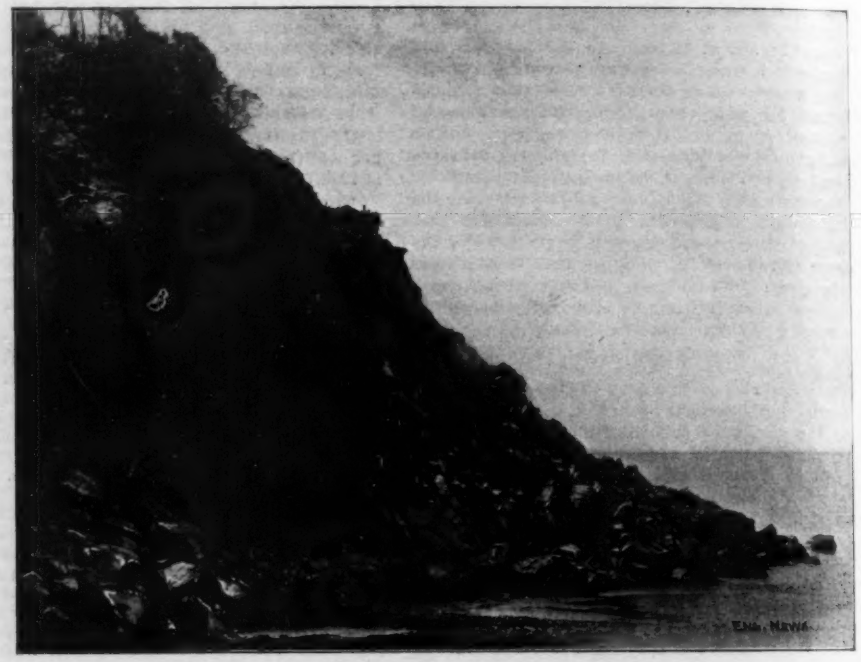


FIG. 2. ROCK TO THE AMOUNT OF 250,000 TONS, THROWN DOWN BY THE BLAST.

A LARGE DYNAMITE BLAST AT MANILA HARBOR: FATAL ASPHYXIATION BY THE AFTER FUMES.

An accident of a very unusual character occurred Dec. 14, 1903, near Manila Harbor, at the Mariveles quarries. Some 45 tons of explosives were charged in chambers about 100 ft. back from the face of the quarry and fired by electricity from a launch. About ten minutes after the blast had been fired, men from the launch went ashore to see the effect of the blast, and in so doing eight men lost their lives. According to "The Manila Times," dense black and yellow smoke was still ascending from many fissures in the rock when the men landed, and one of the native laborers was immediately overcome, falling unconscious. In the attempt to rescue this man, four Americans and three natives were asphyxiated, while a score of other men barely escaped a similar death. The Americans who lost their lives were: Joseph Law, General Superintendent of the Quarries; T. W. Strada, Engineer; William H. Stauffer, Superintendent of rock crusher; John Herty, skilled mechanic.

This is not the first large blast that has been fired at these quarries by the Atlantic, Gulf and Pacific Co., of New York City, which has the Insular Government contracts for dredging, breakwater and bulkhead work at Manila Harbor. The first blast, shown in Figs. 1 and 2, was fired a year ago and threw down 250,000 tons of andesite which was used for the original harbor contract requiring over 400,000 tons of rock.

For the second or breakwater contract, about 600,000 tons of rock were required, and the accident above described occurred at the first blast for this additional quantity. It was estimated that some 400,000 cu. yds. of rock would be thrown down by the 45 tons of explosives.

Since writing the foregoing, a copy of "The Manila Cablenews" has been received, bearing out in substance the earlier reports. It is stated, however, that captured Spanish ordnance powder was used in the blast as well as dynamite, and it appears that the larger part of the charge was this ordnance powder. Two tunnels were driven about 100 ft. into the rock and connected by an adit. Chambers were made at intervals into which the explosives were packed. Mr Krusi, vice-president of the Atlantic, Gulf & Pacific Co., is quoted as saying regarding the gas that asphyxiated the men:

> I am of the opinion that it was not carbonic acid gas [CO_2], as has been claimed. I would class it as carbon monoxide [CO] generated, in the corridors leading to and from the mines, by the explosion.

Capt. Challeston is credited with having rescued at least 12 of the 20 men who were overcome by the gas, and but for his timely arrival in a row boat and his courageous leadership, the number of deaths would have been doubled. In this later account it is stated that Mr. Law was the first to fall, and that the spot where he fell was perfectly clear of any smoke or fumes.

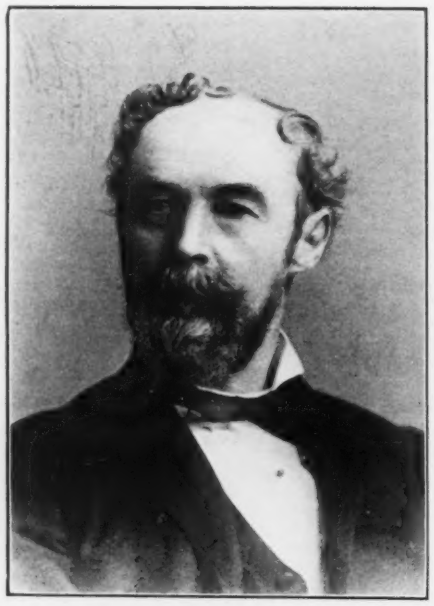
We are indebted to the Atlantic, Gulf & Pacific Co., Park Row Building, New York City, for the photographs accompanying this article.

THE STANDARD FEE SCHEDULE OF THE AMERICAN INSTITUTE OF ARCHITECTS.

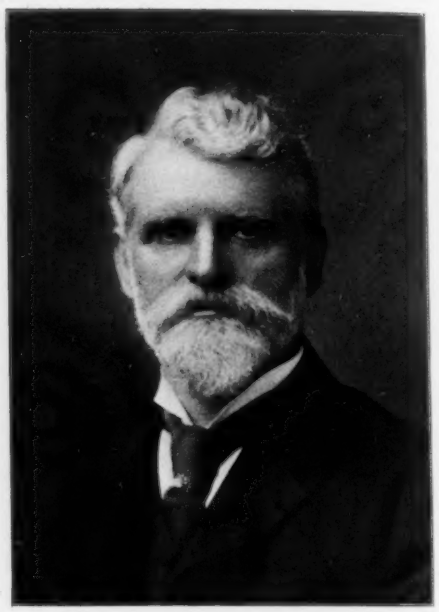
The architectural profession, as most of our readers are aware, long ago adopted through its leading organization, the American Institute of Architects, a standard schedule of fees and charges for professional services. This schedule was revised at the Cleveland Convention in October last and has just been made public in its revised form. In the belief that it will interest many of our readers we reprint it below:

PROFESSIONAL PRACTICE OF ARCHITECTS, AND SCHEDULE OF USUAL AND PROPER MINIMUM CHARGES.

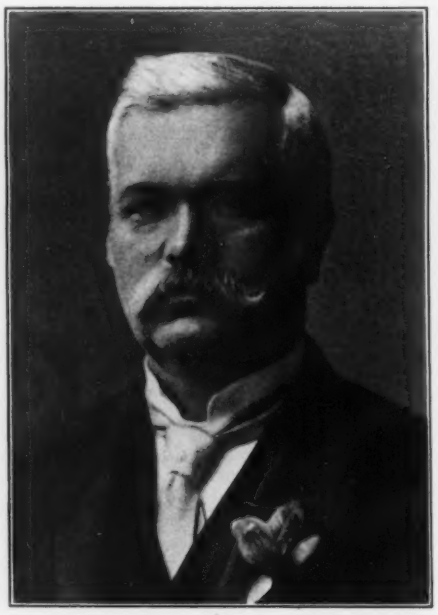
The architect's professional services consist in making the necessary preliminary studies, working drawings, specifications, large scale and full size details, and in the general direction and supervision of the work, for which



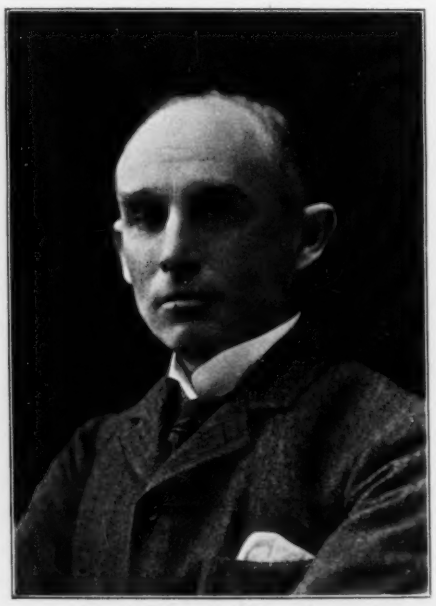
President of the
American Society of Civil Engineers.



President of the
American Society of Mechanical Engineers.



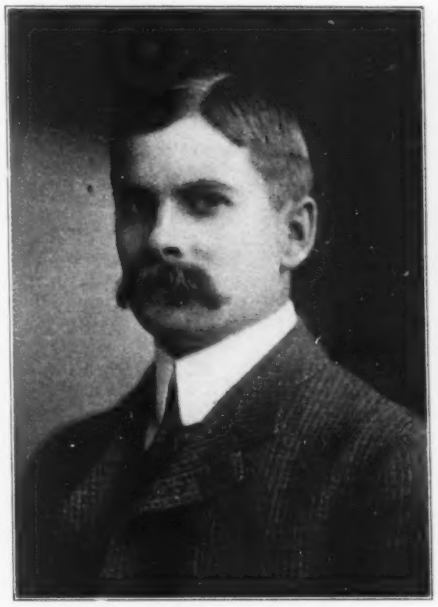
President of the
Canadian Society of Civil Engineers.



President of the Society of
Naval Architects and Marine Engineers.

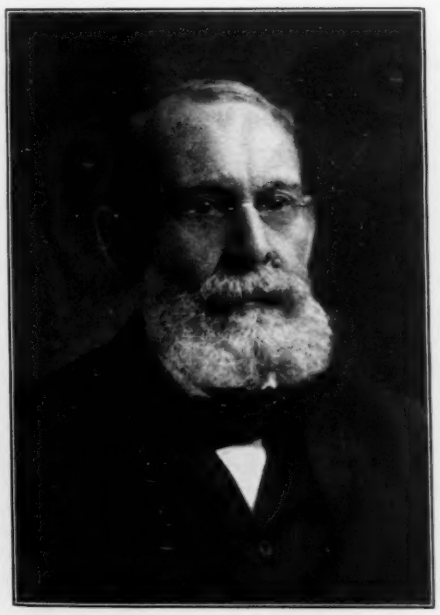
a. R. Ledoux

President of the
American Institute of Mining Engineers.



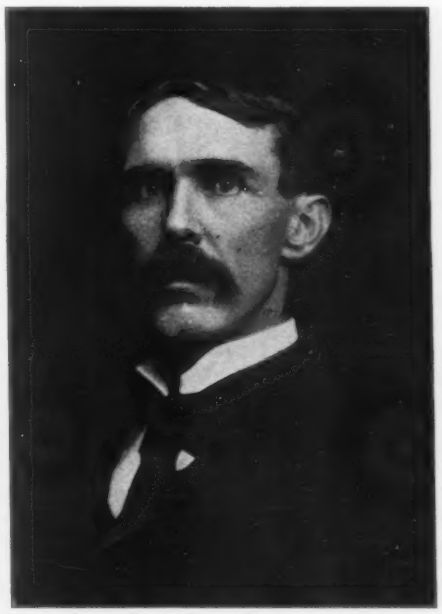
Bion J. Arnold

President of the
American Institute of Electrical Engineers.



Chas. B. Dudley

President of the
American Society for Testing Materials.



Hunter McDonald

President of the American Railway Engineering and
Maintenance of Way Association.

the minimum charge is 5% upon the cost of the work.

For new buildings, costing less than ten thousand dollars, and for furniture, monuments, decorative and cabinet work, it is usual and proper to charge a special fee in excess of the above.

For alterations and additions to existing buildings, the fee is 10% upon the cost of the work.

Consultation fees for professional advice are to be paid in proportion to the importance of the questions involved.

None of the charges above enumerated covers alterations and additions to contracts, drawings and specifications, nor professional or legal services incidental to negotiations for site, disputed party walls, right of light, measurement of work, or failure of contractors. When such services become necessary, they shall be charged for according to the time and trouble involved.

Where heating, ventilating, mechanical, electrical and sanitary problems in a building are of such a nature as to require the assistance of a specialist, the owner is to pay for such assistance. Chemical and mechanical tests, when required, are to be paid for by the owner.

Necessary traveling expenses are to be paid by the owner.

Drawings and specifications, as instruments of service, are the property of the architect.

The architect's payments are due as his work progresses in the following order: Upon completion of the preliminary sketches, one-fifth of the entire fee; upon completion of working drawings and specifications, two-fifths; the remaining two-fifths being due from time to time in proportion to the amount of work done by the architect in his office and at the building.

Until an actual estimate is received, the charges are based upon the proposed cost of the work, and payments are received as instalments of the entire fee, which is based upon the actual cost to the owner of the building or other work, when completed, including all fixtures necessary to render it fit for occupation. The architect is entitled to extra compensation for furniture or other articles purchased under his direction.

If any material or work used in the construction of the building be already upon the ground or come into the owner's possession without expense to him, its value is to be added to the sum actually expended upon the building before the architect's commission is computed.

In case of the abandonment or suspension of the work, the basis of settlement is as follows: Preliminary studies, a fee in accordance with the character and magnitude of the work; preliminary studies, working drawings and specifications, three-fifths of the fee for complete services.

The supervision of an architect (as distinguished from the continuous personal superintendence which may be secured by the employment of a clerk of the works) means such inspection by the architect, or his deputy, of work in studios and shops, or of a building or other work in process of erection, completion or alteration, as he finds necessary to ascertain whether it is being executed in conformity with his drawings and specifications or directions. He is to act in constructive emergencies, to order necessary changes and to define the true intent and meaning of the drawings and specifications, and he has authority to stop the progress of the work and order its removal when not in accordance with them.

On buildings where the constant services of a superintendent are required, a clerk of the works shall be employed by the architect at the owner's expense.

THE PRESIDENTS OF EIGHT AMERICAN ENGINEERING SOCIETIES.

(With inset sheet of portraits.)

For a number of years it has been the custom of Engineering News to publish in a January issue the portraits and biographies of the men chosen as Presidents of the four most prominent American Engineering Societies, those devoted to Civil, Mechanical, Mining and Electrical Engineering.

With the present issue a new departure is inaugurated by adding to this list the Presidents of four other American engineering societies of national scope, being the Society of Naval Architects and Marine Engineers, the American Railroad Engineering and Maintenance of Way Association, the American Society for Testing Materials and the Canadian Society of Civil Engineers.

The Society of Naval Architects has once before been included on our inset sheet, in 1897, when through the re-election of a President of the Institute of Electrical Engineers, space became available for another portrait on an inset sheet, Mr. Clement A. Griscom was at that time President of the Society of Naval Architects, and has been continuously re-elected to that position until the annual meeting of two months ago, when he declined to serve further, and Admiral Bowles was chosen to succeed him.

The Railway Engineering Association and the Society for Testing Materials are each comparatively young organizations; but their rapid growth, their very successful meetings and the character of their membership give every promise that they will enjoy a long and prosperous life.

The Canadian Society of Civil Engineers was established in 1887. It has a membership of over 1,000, and the support given it by the legislatures of the Canadian provinces is good evidence that it is destined to be the great national engineering society of Canada.

We present below biographical notes of interest regarding each of the men whose portraits appear on our inset sheet.

Charles Hermany.

Mr. Charles Hermany, whose election as President of the American Society of Civil Engineers was announced at the annual meeting in New York last week, was born in Lynn Township, Lehigh County, Pa., on October 9, 1830. He was the son of Samuel and Salome (Wannemacher) Hermany. His American ancestors in both the paternal and maternal lines were of German, French and English stock, who immigrated to this country between 1720 and 1740 and settled in southeastern Pennsylvania.

Young Hermany's father was a practical farmer, and the son grew up on the paternal acres, receiving a practical knowledge of agriculture in such duties as fall to the lot of the American boy on a farm. His early education was in the schools of his native town and he was prepared for college by two terms of study in the Minerva Seminary, at Easton, Pa. His further collegiate education, however, was cut short by financial conditions which made it impracticable, and its loss caused him much disappointment. He had early developed a taste for mathematics and a desire to become a civil engineer. Yielding, however, to the necessity which defeated the immediate realization of his object, he went to work on his father's farm, laboring there for three years in the summer and teaching school in the winter. At the same time he devoted all of his spare time to the study of mathematics and engineering, and at odd times practiced land surveying in the field.

In May, 1853, at the age of 23, he left his father's house and went to what was then the West, settling at Cleveland, O., where he was fortunate enough to find an opportunity for work along the lines of his chosen profession, being given a place in the office of the City Engineer of Cleveland, Ohio. In less than a year he was promoted to be first assistant, and he served as principal assistant in the department until May, 1857.

He then went to Louisville, Ky., which was at that time projecting a system of water-works, and entered the service of the Louisville Water Co. as first assistant to Mr. T. R. Scowden, then chief engineer of the company. In this capacity he served in the construction of the Louisville Water-Works, which were completed and went into operation in October, 1860. On Jan. 1, 1861, he was appointed Chief Engineer and Superintendent of the water-works, and he has served in that position continuously until now. It is rare, indeed, in the records of American engineering to find a man holding such a prominent position continuously for a period of more than forty years. In fact, it is now nearly 47 years that Mr. Hermany has been connected in a responsible position with the Louisville Water-Works.

The problem which Mr. Hermany has had to solve at Louisville has been that of delivering a water supply from a river with a variation of more than 40 ft. between high and low water. He has done this for all these years without a moment's interruption, while other cities more favorably situated have experienced annoying disappointments.

The first reservoir constructed at Louisville had a capacity of ten million gallons, which in less than twenty years proved inadequate for the city's supply. This necessitated the enlargement of the system, which was equivalent to the construction of a new one. The present reservoir was then built, with a capacity of one hundred million gallons, for the supply of which a new pumping station, pumps and engines were needed. The difficulties to be overcome in the erection of the pumping station on a secure foundation, caused the design and recommendation of a pneumatic caisson upon which to build, and with which to sink to the required depth a chambered pump-house and engine supporting structure. The contract was successfully bid for by, and awarded to, an experienced and responsible contracting firm, who afterward declined to execute it, and paid the stipulated forfeit. A second letting resulted in bids deemed too high, and the undertaking was thus practically classed as being hampered with a hazardous design. This situation finally resulted in the construction of not only the foundation, but the superstructure and appurtenances by Mr. Hermany himself, with day labor. The work involved five years of the closest supervision and most exacting responsibilities. Mr. Hermany was also chiefly responsible for the design of the sixteen million gallon pumping engine which was erected in this house. Of this engine, Mr. F. W. Dean, one of the experts who tested it, in a paper read before the American Society of Mechanical Engineers in 1894, said: "The engine ran 144 hours and 10 minutes without a stop, which is the longest test on record, and established itself as the most economical compound engine that has ever been tested, so far as the writer knows."

In 1890 Louisville was visited by a disastrous tornado, the tall stand-pipe at the pumping station, from which the reservoir was supplied, was demolished and a water famine was threatened. There was no time to rebuild the stand-pipe, but by Mr. Hermany's prompt and skillful work, what remained of the stand-pipe was utilized as an air chamber and the water was pumped direct from the river to the reservoir.

Besides his work at Louisville, Mr. Hermany has had much to do with a number of other water supply plants in the Middle West. As chief engineer he designed and constructed the water-works at Bowling Green, Lakeland and Frankfort, in Ohio, and he has designed and is constructing the new water-works at Evansville, Ind. For years he has had a considerable consulting practice in connection with municipal water supplies.

When the question of water purification at Louisville came up in 1895 for practical consideration, Mr. Hermany projected and directed the experiments which were made by Mr. Geo. W. Fuller for the Louisville Water Company. The Louisville experiments were the pioneers in this field, being followed later by experiments at Cincinnati in 1898, at Pittsburgh in 1899, and at New Orleans in 1902.

After the Louisville experiments were concluded, Mr. Hermany designed the filters for the Louisville Water Company, which are now in process of construction.

He is at present also one of the consulting engineers for the construction of the new water-works at Cincinnati, O.

Mr. Hermany was elected a merber of the American Society of Civil Engineers in 1869. He is also a member of the Franklin Institute, the American Water-Works Association, and the Engineers and Architects' Club of Louisville, Ky.

Ambrose Swasey.

Mr. Ambrose Swasey, who was elected President of the American Society of Mechanical Engineers at the annual meeting in December, 1903, was born in Exeter, N. H., December 19, 1846. His ancestors were among the early settlers of New England, successive generations having lived in his native town for nearly two centuries. His early education was in the "red brick school house" of the district, but as his natural bent was in the line of mechanics, he chose the machinist's trade, which he learned in a shop in his native town, where steam engines were manufactured. It was here that he first met Mr. Worcester R. Warner, his present partner. In 1870, in company with Mr. Warner, he went to Hartford, Conn., and entered the employ of the Pratt & Whitney Co. While there Mr. Swasey developed such a capacity for accurate workmanship and the solution of complex mechanical problems, that he was given the entire charge of the gear work, and devised machinery for generating the epicycloidal curves of cutters used for cutting the teeth of spur wheels, and later he invented and

perfected a machine for automatically generating and cutting the teeth of interchangeable gear wheels. In 1880 again in company with Mr. Warner he went westward and located in Cleveland, O., where under the firm name of Warner & Swasey they erected shops and engaged in the manufacture of machine tools.

In addition to their regular line of work, this firm has given special attention to the construction of astronomical instruments, many of which up to the present time have been imported from Europe. In this field Mr. Warner's taste for and knowledge of astronomy combined with Mr. Swasey's fondness for and success in the solution of intricate mechanical problems led to the introduction of new features in equatorial telescopes, which have made them famous, not only in this country, but abroad.

Among their notable achievements was the designing and constructing of the mounting for the 30-ft. Lick telescope, which was not only the greatest refracting telescope ever made, but was the first instrument to be adapted to the triple purpose of visual, spectroscopic and photographic work. Although this telescope was completed and erected sixteen years ago, yet the perfection of the instrument is such and the atmospheric conditions so superb on Mt. Hamilton, California, where it is located, that to-day this telescope is appealed to by astronomers throughout the world when differences of opinion arise regarding observations. The mounting of the Lick telescope proved to be so admirable in every respect that in 1892 the U. S. Government entrusted to this firm the mounting of the 26-ft. telescope of the Naval Observatory, and in 1893 the 40-ft. telescope of the Yerkes Observatory, which is the largest refracting telescope up to the present time, together with its 90-ft. dome and 75-ft. elevating floor were also constructed by this firm.

In addition to these telescopes, the manufacture of meridian circles, transits and other instruments especially adapted for astronomical work has formed a very considerable and important proportion of the business of this firm. Only a few years ago Mr. Swasey took up the problem of making a dividing engine of sufficient accuracy for astronomical work, and perfected an engine capable of automatically dividing circles up to 40 ins. in diameter, with an error of less than one second of arc. In its construction it was necessary to inlay silver bands near the periphery of the master plate, and on these bands are graduations so fine that they can scarcely be seen with the naked eye. The width of each of these lines is not more than twelve seconds of arc, and yet it is twelve times the maximum error in the automatic graduations which the instrument produces.

For the last few years our government has been giving special attention to the development of instruments of precision for use in our sea coast defence, and many of the instruments which have been adopted, such as telescopic gun sights of several different patterns, azimuth instruments, etc., have been designed by Mr. Swasey. Recently he was requested to take up the difficult problem of producing a range finder for determining the position and distance of a ship or target within a range of 12,000 yds. After the first instrument was completed, it was subjected to exhaustive tests by a special board of officers and their report was so highly satisfactory that the "Swasey Range Finder" was adopted by the government, and many of these instruments have since been made.

Mr. Swasey became a member of the American Society of Mechanical Engineers at its organization in 1880, and served as Vice-President in 1900 and 1902. It is worthy of note that his partner, Mr. W. R. Warner, was also President of the Society in 1897. Mr. Swasey is a member of the Institution of Mechanical Engineers and the British Astronomical Association, and is a Fellow of the Royal Astronomical Society. He is past President of the Civil Engineers' Club of Cleveland, and in 1900 he received from the French Government the decoration of the Legion of Honor.

Mr. Swasey has large interests outside of his regular business, and is on the governing boards of some of the largest banking institutions in Cleveland, yet, in the midst of his various duties, he has found time to travel extensively, and but a few months since returned from a journey around the world.

Dr. Albert R. Ledoux.

Dr. Albert R. Ledoux, President of the American Institute of Mining Engineers, was born on Nov. 2, 1852, in Newport, Ky. His father, Rev. Louis Palemon Ledoux, D.D., was a Presbyterian minister and educator of distinguished personality and attainments; a graduate of Amherst College, and of the Union Theological Seminary in New York; a native of Louisiana, his ancestors having been Norman French. He married Katharine C. Reid, of New York city.

Most of the boyhood of Albert R. Ledoux was passed among the Highlands of the Hudson, his home having been at Cornwall, N. Y., where his parents resided after 1858. Doctor Ledoux was prepared for college under his father's guidance, and entered the Mining Engineering Course of the School of Mines of Columbia University in 1870. In 1873 he matriculated at the University of Berlin, Germany, where he spent two years studying Physics, Chemistry and Mineralogy. After attending lectures at Heidelberg and at Goettingen, he successfully passed the examination of the latter university, receiving the degrees of M. A. and Ph.D., the diploma being awarded "Propter Insignem Chemiae et Mineralogiae Scientiam Dissertatione."

Returning to America, Dr. Ledoux spent a few months as assistant in a New York commercial laboratory, from which he was called to be the first State Chemist of North Carolina. At that time the position carried with it ex-officio membership in the Faculty of the State University. Dr. Ledoux organized a staff of assayers, and for three years had charge of all the analyses and experiments conducted by the State Board of Agriculture, the State Board of Health (of which he was also a member), and of the assays and analytical investigations of the Geological Survey.

On resigning his position in North Carolina in 1880, the State University gave him the honorary degree of M. S. He then opened an office in New York city as Consulting Mining Engineer and Chemist, in partnership with Dr. P. de P. Ricketts, then Instructor in Assaying in Columbia University. Upon the expiration of the partnership in 1885, and upon the retirement of Dr. Ricketts, the latter was succeeded by a younger brother of Dr. Ledoux, Augustus D. Ledoux, at present a well-known Chemical Engineer and New York agent of the Rio Tinto Co. The firm of Ledoux & Co. continued as a partnership until 1899, when the growth of the business necessitated incorporation. The firm of Ledoux & Co. has been recognized the world over as assayers, its certificates passing current in Hamburg, Paris and Berlin; a very large proportion of the copper ores, bars and other unrefined copper products sold for export being settled for in New York on Ledoux & Co.'s certificate of weight, sampling and assay. Ledoux & Co. also handles at its public ore-sampling works at the Port of New York, or at the refineries on the Atlantic Coast, a very large part of the copper product of the country that requires refining. Practically the entire copper product of Arizona and of Northern Mexico passes through its hands, and the same may be said of the output of British Columbia and part of Montana. Some of the largest foreign producers also sell their product on Ledoux & Co.'s assays; for instance, the Mt. Lyell Mining & Railway Co., of Australia, whose product is refined at Baltimore.

It is interesting to note the measurably accidental beginning of the acceptance of Ledoux & Co.'s certificates by foreign buyers. A cargo of ore reached New York; was sampled by Ledoux & Ricketts on the docks, and was retransferred to ocean steamer for shipment to Swansea. When the assays were completed, the New York buyers stated that the results were very much too high, and intimated the possibility of fraud on the part of the sellers' representatives—in other words, that the samples had been salted. The matter was about to be taken up at law when Dr. Ledoux proposed that they send their chief assayer by fast steamer to Swansea; that he should associate with him one of the foremost assayers of Great Britain; that the ore should be resampled on arrival, jointly with the representatives of the English buyers. If the results proved that Ledoux & Ricketts' samples had been tampered with, they were to bear the entire expense of the investigation; but if the results confirmed their New York assays, all expenses were to be paid by the New York complainants, together with extra compensation. The case attracted considerable attention among the ore buyers of Great Britain, and the sampling was watched with considerable curiosity. American methods were followed, and the results confirmed the American assays. This object lesson in the heart of the ore-buying district of Wales convinced one, at least, of the progressive English smelters that American methods were reliable and American assays correct, for soon after James Lewis & Son, of Liverpool, offered to buy three thousand tons of copper matte from Mr. W. A. Clark, of Montana, and to settle for the same in New York funds on American weights, sampling and assays, payment being made against delivery on steamer at New York. This business, once begun, has continued ever since, and all foreign buyers have followed suit.

Prior to that time, the Anaconda and other Montana mines had been shipping their high-grade ore and their partially refined product to Great Britain, being compelled to settle on the landing weights and on the results of tests by Cornish assayers. The methods employed abroad in assaying and in weighing were empirical, and when not understood resulted in apparent losses to sellers, to say nothing of the length of time required before they could receive pay for material shipped from the Western States of this country. The Cornish system of assay had undergone no change for one hundred and fifty years, and was supposed to imitate in a crucible the operations of refining copper ores, etc., by hand labor, in hearth furnaces, before the introduction of the Bessemer furnace or, for that matter, the general use of the water jacket cupola for copper.

In addition to being at the head of the business of Ledoux & Co., Dr. Ledoux has been active as Consulting Engineer for many important mining and other corporations, and his professional reports would make a considerable volume, if printed. For some years he was retained by the Great Northern Railway and personally examined and reported upon several sections through which it was proposed to build the Western extension of this road, particularly upon the mineral resources of the Lake Kootenay region (1889), the geological and mineral development of the Sweet Grass Hills region, in northern Montana, and as to the duration of copper production in the mines of Butte, Mont. Dr. Ledoux is considered more especially an authority on copper mines, and has examined and reported upon the Boundary Creek District of British Columbia, the prospects for copper production in Taos county, New Mexico, etc., etc. He is also considered an authority on the pyrites deposits of the Alleghanies and Eastern States, having examined the principal copper and pyrites-producing mines from Vermont and New Hampshire to North Carolina, particularly those near Mineral City, Va.

For two years Dr. Ledoux was expert of the commission having in charge the selection of a method of burying the then overhead electric wires in New York city. As Receiver of the Harney Peak Tin Mining, Milling & Manufacturing Co., he has had charge of the South Dakota properties, and he conducted for Phelps, Dodge & Co. a thorough test, lasting the greater part of a year, of the tin prospects in the vicinity of Kings Mountain, N. C. He has also studied and reported upon the tin deposits of Virginia. One of his earliest reports was upon the saving of values from the tailings of the principal mines near Pachuca, Mex.; one of his latest was on a survey and test of the nickel deposits of Southern Oregon.

Dr. Ledoux was for some years the consulting engineer of a syndicate which subsequently incorporated as the Great Northern Mining & Development Co., of which he was elected president. He successfully conducted their mining operations in Fergus county, Mont., and elsewhere. He is at present interested with Walter B. Devereux, E. W. King and others in the development of mines in the vicinity of the town of Kendall, in the same

county. Dr. Ledoux is frequently called to court as expert in chemical and engineering cases, and is retained by several manufacturing and metallurgical works in an advisory capacity.

In addition to the Presidency of the American Institute of Mining Engineers, Dr. Ledoux is a fellow of the American Association for the Advancement of Science, a member of the New York Academy of Sciences, the American Institute of Electrical Engineers, American Chemical Society, the Society of Chemical Industry of Great Britain, the Society of Medical Jurisprudence, and the Canadian Mining Institute.

In giving the dates and data of the professional career of a man, it goes without saying that such success as he has achieved is not simply dependent upon his education and experience, but upon his personality: for this reason we have secured from a gentleman whose acquaintance with Dr. Ledoux is of many years standing the following estimate, which we take pleasure in publishing:

During his college course, and while a member of the Faculty of the State University of North Carolina, Dr. Ledoux especially left his mark upon the young men with whom he was associated. By his lectures and by his personal examples he created in them enthusiasm for Science, and, in many cases, higher ideals of life and duty.

A Presbyterian by birth and conviction, he has long been intimately connected with the Christian life and work of New York city, not only through the Brick Church, of which he has been an officer for twenty years, and which he represented as a Liberal in the trial of Dr. Briggs for heresy, but also through many other religious and philanthropic societies, hospitals and other institutions.

Some men have merely the ability of their calling, while others seem as though they could have achieved equal success in any line: In this latter and worthier class we would place Dr. Ledoux. His scientific papers and addresses are recognized as authoritative abroad as well as in this country, but those who have read his Nature Sketches, which have appeared in the magazines from time to time, and his little volume of Short Stories, published in 1896, cannot but be impressed with his talent in lines widely different from that of his chosen profession.

The characteristics of Dr. Ledoux as a man, beyond his personal magnetism and his love of "God's out-of-doors," to borrow one of his favorite phrases, are his certainty of intellectual grasp and quickness of perception, his breadth of interest and of culture, his unfailing tact—his kindliness, his magnanimity, and last, but by no means least, a certain strain of old-time chivalry, perhaps inherent in the blood.

Bion Joseph Arnold.

The American Institute of Electrical Engineers pursues the policy of electing young men to its highest office, whereas in the Civil and the Mechanical Engineers' Societies the nominating committees usually cast about for nominees among the men who have already a life time of professional work to their credit. Among the Electrical Engineers, however, hoary heads are extremely rare. The men who stand at the head in electrical engineering work are the men who were young enough to learn the art of electrical engineering when its practical development began, fifteen or twenty years ago.

Mr. B. J. Arnold, who succeeded Mr. Chas. F. Scott as President of the American Institute of Electrical Engineers last summer, is a native of Michigan. He was born at Grand Rapids in 1861. Three years later his parents removed to Ashland, Neb., where his boyhood was spent. He early showed a strong bent for mechanical pursuits, and after receiving a common school education in the Ashland schools, he began an engineering course at the University of Nebraska in 1879. After a year there, he went to Hillsdale College, Michigan, from which institution he graduated in 1884, receiving high honors. His first position after graduation was as a general agent for an engine builder. After two years at this work he entered the drafting room of the Edward P. Allis Co. at Milwaukee. He left this position in a short time to become Chief Designer for the Iowa Iron Works at Dubuque. About this time the Chicago, St. Paul & Kansas City Ry., now the Chicago, Great Western system, was under construction, and Mr. Arnold became a member of the Chief Engineer's staff. When the road was completed and ready for operation he was appointed Mechanical Engineer for the company.

In 1888, feeling that the new field of electrical engineering offered great attractions, Mr. Arnold resigned his position and went to Cornell University, where he spent several months taking a post-graduate course in electrical engineering. In April, 1889, he was placed in charge of the St. Louis office of the Thomson-Houston Co. as engineer and agent. Two years later, at the age of 30, he was appointed Consulting Engineer for the Chicago office of the company, in which position he was retained after the absorption of the Thomson-Houston organization in the General Electric Co. While holding this position he designed the power plant of the Intramural elevated railway at the Columbian Exposition, which was the first example of the application of electric traction on an elevated railway line.

Shortly after this, desiring more scope to work out his own ideas, he resigned his position and began practice as a consulting engineer, making a specialty of electric power station design. The station at Little Rock, Ark., one of the earliest built from his designs, was illustrated in Engineering News in January, 1893.

About this time Mr. Arnold became much interested in the development of the storage battery, and he obtained control of some patents in this field, which he deemed to be important. On the organization of the Electric Storage Battery Co., a short time afterward, control of these patents was found to be essential, and Mr. Arnold's judgment was vindicated by the sale of these patents to the company for a large sum.

The capital thus placed in his hands he made good use of in a business way. He organized the Arnold Electric Power Station Co., which took up the work of power station construction under the patents controlled by him, and he is still President and Technical Director of this corporation. For several years past he has devoted a large part of his time to electric railway construction and equipment, and has built a number of important roads. As Consulting Engineer he prepared last year an exhaustive report for the Chicago City Council on the entire street railway system of that city. Probably the most important work he has ever done and one of the greatest tasks ever delegated to a consulting engineer was the investigation regarding the electrical operation of the trains entering the Grand Central Station in New York city. As a result of that report, the entire work of electrical installation has been put under contract.

Mr. Arnold himself, we believe, regards his most important piece of work to be the invention and development of the electric-pneumatic railway system for interurban service, described and illustrated in our issue of Jan. 7. The demonstration of that system in practical operation will certainly be awaited with great interest by the engineering profession.

Doubtless the best indication of Mr. Arnold's character is furnished by his action when ten years ago, as related above, he was placed in possession of a fair-sized fortune. A man of different sort might have chosen to relinquish active business and take life easy. A man of worse sort might have started on a career of dissipation. To Mr. Arnold the stroke of good fortune meant merely opportunities for greater activity in a larger field. He is a man who finds pleasure in "doing things."

Notwithstanding the large amount of responsibilities which Mr. Arnold carries, he finds time for membership in a number of professional and other organizations. He has served as a Manager of the American Institute of Electrical Engineers, of which he is now President. He was one of the charter members and first directors of the Technical Club, of Chicago. He is also a member of the Union League Club, of Chicago; of the American Association for the Advancement of Science; of the American Society for the Promotion of Engineering Education; of the board of governors of the Chicago Automobile Club, and of the Transportation Club, of New York.

Col. Wm. P. Anderson.

Lieut.-Col. William Patrick Anderson, the new President-elect of the Canadian Society of Civil Engineers, has been identified with that flourishing institution since its inception in 1887, when he represented Ottawa on the committee selected to organize it and draft its constitution. He has since served several years as Member of Council and later as Vice-President.

He was born near Quebec in 1851, of English-Irish parentage. His father, Thomas Anderson, was well known in Quebec as a timber merchant, and later organized the Crown Timber branch of the Canadian government at Edmonton, where he still lives, a hale and vigorous advocate of the immense possibilities of the far Northwest. Col. Anderson was educated at Bishops' College, Lennoxville, and after passing some years in office work in Quebec, spent three years, 1872-4, in Manitoba and the Canadian Northwest, on surveys and railway explorations.

Returning east in 1874 he entered the Dominion Department of Marine and Fisheries as a draftsman, and has remained in that department ever since, rising successively to the grades of Assistant Engineer, Engineer and Chief Engineer. His duties are officially defined "as embracing most of the technical work at departmental headquarters, including the construction of lighthouses, lightships, fog alarms, buoys and beacons; supervision of construction and repairs to government steamers and the construction and equipment of lifeboats; the administration of the vote for the removal of wrecks and obstructions in navigable waters; tidal and current surveys; hydrographic surveys, and the publication, examination and correction of hydrographic charts; construction of and repair to fish hatcheries and refrigerators; engineering points in connection with the construction and maintenance of fish passes; supervision of surveys of oyster beds; examinations for applications for foreshore, wharf and water lots as they affect the interests of navigation; preparation and publication of notices to mariners and hydrographic notes."

In a country like Canada, with a very extensive coast line, on which it was necessary to increase rapidly aids to navigation, and with a very limited revenue, making restricted expenditure only possible, the task of providing these aids to navigation to meet the demands of shipping was no easy problem. It was solved by the subject of this sketch by providing cheap wooden buildings surmounted by efficient illuminating apparatus, and by the practice of rigid economy. During the 24 years that he has been Chief Engineer of the department he has designed and erected over 300 lighthouses and 50 mechanical fog alarm installations. Of late years a larger annual appropriation has been available for construction, and the size and stability of his later designs have been correspondingly improved.

Amongst the best of his works may be mentioned the design and construction in 1885 of a lighthouse on a masonry pier, built in a steel caisson in 13 ft. of water on Colchester reef, Lake Erie; in 1897 he installed a first-order siren station at Belle Isle, Labrador, compressing the air by a Pelton water wheel, fed from lakes on the hills of the island. This is the only fog alarm known operated by water power, and has proved remarkably efficient and economical in operation. In 1900 he built a lighthouse at the upper end of the Traverse of St. Roch, in the River St. Lawrence, below Quebec. This stands on a pier sunk in 42 ft. of water, with a 7-knot tideway, and is considered a good piece of engineering in view of the heavy current and great weight of ice to be resisted in winter. In 1902-3 he built another lighthouse at the lower end of the same Traverse in the same depth, but with two knots more current. This is a larger and more substantial structure, fireproof throughout; the pier being of concrete in a steel casing, and the superstructure of concrete and metal. This lighthouse will be equipped with a modern quick-flashing English light, and with a first-class fog alarm operated by oil engines. In the same years he built a lighthouse at Pelee middle pound, Lake Erie, in 14 ft of water, fireproof throughout. The foundation is of concrete, built in a steel caisson; the tower is of steel plate, brick lined; the illuminating apparatus is quick-flashing, revolving in mercury, and the fog alarm is operated by a steam plant located in the foundation pier. He has now under construction by the Polson Works, Toronto, two steel lightships, with steam propulsion and auxiliary engines, electric lights, and fog sirens operated by compressed air. One is intended for the

Gulf of St. Lawrence, and the other for the Bay of Fundy.

Col. Anderson is also practically Hydrographer to the Dominion government, having under his supervision the hydrographic surveys of the department and the issue of notices to mariners. This work has now been systematized and results in the publication of a large volume of important information promptly issued. In 1893 he personally made a hydrographic survey of the Bay of Quinte, an arm of Lake Ontario 70 miles long, the results of which have been embodied in two Admiralty charts.

Until this winter he was General Superintendent of Lighthouses, but his engineering work has increased so rapidly with the development of Canada, and gives promise of so much future increase, that he was relieved of the control of maintenance of aids to navigation, in order that he might have more time for his technical duties.

Col. Anderson has always been identified with the volunteer movement in Canada, and is an enthusiastic rifle shot. He has served in several well-known corps, rising to the command of the 43d Battalion of Rifles (whence his military rank), and when he retired from that command in 1891 he was retained on the active list without duty. He has several times won his place on the rifle team sent to represent Canada in England, and in 1895 shot at Bisley for Canada; he has also won several of the best prizes at the Dominion rifle meetings. He is a member of the council and executive committee of the Dominion Rifle Association.

He has always taken an interest in scientific and educational work, and has held office in all the organizations of the Canadian capital having literary, scientific or educational aims. At present he is Chairman of the School Management Committee of the Public School Board of the city of Ottawa. He is also a member of the executive committee of the Geographic Board of Canada, organized by the Government to control the spelling and application of place names in Canada, a board that has already done much to improve and unify the nomenclature of the Dominion.

Francis Tiffany Bowles.

Mr. Francis Tiffany Bowles, elected President of the Society of Naval Engineers and Marine Architects at the annual meeting in November, was the son of Benjamin H. Bowles and Mary Elizabeth Bailey. He was born in Springfield, Mass., October 7, 1858. His grandfather, Samuel Bowles, was the founder, and his uncle, the famous editor Samuel Bowles, of the "Springfield Republican." The family is of clear New England Puritan stock and allied on every side with well-known Puritan names.

In 1875 Mr. Bowles entered the Naval Academy as a Cadet Engineer. Early in the course he determined to become an Assistant Naval Constructor. Although provided for by law, no appointments had ever been made from graduates of the Naval Academy owing to the opposition of the old school of constructors.

In order to thoroughly equip himself as a naval architect, Mr. Bowles applied, during his last year at Annapolis, for permission to attend the School of Naval Architecture at the Royal Naval College, Greenwich, England. His request being seconded by Senators Edmunds and Dawes, the Secretary of the Navy made application to the English government for Mr. Bowles and his classmate, Richard Gatewood, to take the three years' course. These young men began then in 1879 a course of study which has since been the highest prize attainable by distinguished graduates of the Naval Academy, and has proved a most valuable method of recruiting an efficient corps of Naval Constructors. Mr. Bowles' instructor in Naval Architecture was Sir William White, late Director of Naval Construction of the British Admiralty.

Mr. Bowles, coming fresh from the English and Scotch shipyards in October, 1882, and charged with the latest information as to design and construction, was soon detailed as Secretary of the Naval Advisory Board, then charged with the control of the design and construction of the first ships of the New Navy. It is difficult to realize now the then-existing condition of dense ignorance as to the real state of the art of ship and engine building, and Mr. Bowles was met with the most absolute incredulity as to the results obtained abroad. It is interesting to recall that the ships recommended for the Navy by the first Advisory Board were all single-screw vessels, even up to a first-class cruiser of 6,000 tons. They were all unprotected, sheathed with wood, of full sail power, with gun-deck batteries and speed 10 to 15 knots for the various classes. Twenty of the small vessels were to be built of wood, and on the material for constructing the others the Board divided, part advocating steel and part iron.

Mr. Bowles struggled to introduce new ideas and succeeded in doing so in many portions of the designs. He advocated twin screws for all the ships, which were adopted for the "Chicago." He made and secured the adoption of the battery plans of the "Boston" and "Atlanta." He fought against sheathing with wood and won his case so thoroughly that the question has laid at rest until recently. His services on this Board, which extended over its active service of four years, were described as follows in a letter of the late Rear-Admiral Sampson, at one time President of the Board:

> Mr. Bowles has been attached to the Board since its inception, and, as the center figure about which the business of the Board has circulated, he showed an amount of method and system, which, combined with a very retentive memory, has made him a valuable and, I may say, an unfailing reference at all times. This, however, would indicate but faintly the value of his services, which could not have redounded to the credit of the service and his own reputation, without the knowledge he possesses of marine architecture and engineering, both of which have been frequently utilized by the Board.

Secretary Whitney made Mr. Bowles a member of the Walker Board, which prepared the designs of the "Newark," "Charleston," "Yorktown," etc.

In 1886, Mr. Bowles was detailed to the Norfolk Navy Yard, and was soon placed in charge. He there organized a modern shipbuilding plant, producing with the very small means available the Navy's most efficient yard. He built the battleship "Texas," the cruiser "Raleigh," and completed the monitor "Amphitrite." During this tour of duty, extending over nine years, he served as a member of all important Boards at Washington having to deal with matters of ship design.

On his departure from Norfolk the employees adopted resolutions testifying to his "executive ability and skill," and thanking him for "his untiring energy as manifested for the advancement of this yard, in securing the necessary tools and appliances for the construction of vessels," and congratulating him on his promotion to the New York Yard, "the best appointment in the gift of the Department."

Mr. Bowles' administrative and business capacity has always been recognized in the Navy, as well as his unflinching demand for efficient personnel in the Navy Yards. This has frequently brought him into conflict with politicians, and resulted in investigations of his conduct of affairs, which have always resulted in credit to himself and confusion to his enemies.

Secretary Tracy consulted him in regard to the introduction of Civil Service into the Navy Yards, and made large use of his knowledge and experience in framing the first rules put in force.

Mr. Bowles came to the New York Navy Yard in 1895, being detailed by Secretary Herbert at a time when certain irregularities were found in the employment of men in violation of the rules. He proceeded quietly and effectively to rid the place of incapable, idle and worthless employees who had infested it for years, and has produced an organization whose efficiency was demonstrated clearly in the Spanish War, when the work turned out at the yard won the admiration of the Navy as well as the business community.

In September, 1897, desiring the earliest possible completion of the repairs to the large dry-dock at the New York Navy Yard, the Secretary of the Navy placed the work under the immediate charge of Mr. Bowles, by whom it was brought to a successful conclusion and the dock put in excellent condition. Since its completion, all of the largest and heaviest ships in the Navy have been successfully docked therein.

During the Spanish-American War, there were 2,200 construction employees averaging 14 hours per day under Mr. Bowles' orders. Due largely to his remarkable executive ability and quick and correct decision, there were fitted out at the New York Navy Yard, for auxiliary service, 37 vessels —as many as were turned out in all other yards together. Mr. Bowles was further in complete charge of fitting out the Army Hospital Ship "Relief," which for completeness of hospital arrangements is to-day unsurpassed. Secondary batteries were fitted on the "St. Louis," the "Harvard" and the "Yale" without interfering with their movements. In many instances the alterations were outlined, plans made and issued and work begun within twenty-four hours after a vessel's delivery at the yard.

Mr. Bowles was the prime mover in the organization of the Society of Naval Architects and Marine Engineers. From its incorporation he has been Chairman of the Executive Committee of the Council, and has also served as Secretary-Treasurer of the Society. In moving him a vote of thanks, Vice-President Loring, of the Society, said: "In the work of inception and execution, the master mind and guiding hand have been those of Naval Constructor Francis T. Bowles." Col. Edwin A. Stevens, Member of the Council, said:

> I take it that we can regard Mr. Bowles' work in fostering this society . . . . . as an example of the spirit of the service, taking Mr. Bowles as the type of the reconstructed Navy of the United States, of the men that have made that reconstruction possible. Sir Nathaniel Barnaby calls the corresponding English organization "the home for research in naval construction," and due to the efforts of Mr. Bowles, the American society has come to occupy a similar place, and is meeting with great success in its object, "the promotion of practical and scientific knowledge in the arts of shipbuilding and marine engineering and the allied professions."

Mr. Bowles was made a Rear-Admiral in the Navy when he became head of the Bureau of Construction and Repair.

A few months ago Mr. Bowles was offered the Presidency of the Fore River Ship & Engine Co., of Quincy, Mass., and resigned his commission as a Rear-Admiral to accept that position.

Dr. Charles B. Dudley.

Dr. Charles B. Dudley, the President of the American Society for Testing Materials, was born at Oxford, Chenango county, New York, July 14, 1842, of New England parentage, the father being from New Hampshire, and the mother from Connecticut. The movement of the parents from New England to New York State, was a part of that general trend of New England blood toward the setting sun, which so markedly characterized the early part and middle of the last century, and took place at the time when it was going "out West" to go into New York State. Doctor Dudley's early years were spent in attending the village school, and, later the academy, in the fall and winter, and in working on a farm in summer. In 1862 he enlisted as a private soldier in the 114th New York Volunteers, and spent the greater part of the next three years in the War of the Rebellion. He was in seven battles, participating in the siege of Port Hudson in 1863, in the Red River Campaign in the spring of 1864, and was finally severely wounded in the battle of Opequan Creek, just east of Winchester, in the Shenandoah Valley, on September 19, 1864. The studious habits which may be said to have characterized Doctor Dudley's whole life, manifested themselves even during his army service. During one winter while the army was in winter quarters at Franklin, Louisiana, he had his Latin grammar and reader sent to him, and devoted many hours of his camp leisure that winter to a study of that language. The books, which would now be a valuable souvenir, were ultimately lost, owing to the capture of a lot of stored baggage by the enemy.

Returning from the war in 1865, he began to prepare for college at Oxford Academy and Collegiate Institute, and entered Yale College in the fall of 1867, graduating as A. B. in the Class of '71. The next year was spent in newspaper work in New Haven, obtaining means to prosecute further studies, and to pay off obligations already incurred during the previous four years. Having no independent means of his own, Dr. Dudley

obtained quite a portion of the funds needed to secure an education by working at whatever could be found to be done, both in vacation and during term time. In the fall of 1872 he entered the Sheffield Scientific School of Yale College, and graduated in 1874, with the degree of Ph.D., having spent the two years largely in chemical study. His graduating thesis, which was published in extended abstract in the Proceedings of the American Association for the Advancement of Science, was "On Lithium and a Glass Made with Lithium."

The next college year was spent as assistant to Dr. George F. Barker, Professor of Physics, at the University of Pennsylvania, Philadelphia. During this year some translations of technical papers from the German were made, which were published in the Franklin Institute Journal. In September, 1875, Dr. Dudley accepted the position of teacher of the sciences in Riverview Military Academy, at Poughkeepsie, which position he retained only about a month, as on November 10th of the same year he was invited to accept the position of Chemist of the Pennsylvania Railroad Company at Altoona, which position he still holds.

It will be noted that by far the largest portion of Dr. Dudley's active life has been spent in Altoona. When he began his work there, no railroad had a chemist as a regular employee, although many of them had occasional chemical work done. At that time the whole subject of the relation between scientific knowledge and its practical use by railroads was in a very chaotic state. There were very few, if any, specifications. The study of the valuable properties of metals and other materials used in construction may fairly be said to have been in its infancy. Engineers, both civil and mechanical, were largely dependent on the makers of commercial products for their knowledge as to the fitness of these products for the purpose desired; also there was an almost absolute absence of positive knowledge as to whether the thousand and one different articles used by railroads, either in construction or in the supplies that are consumed from day to day, were really what they professed to be. Furthermore, the study of materials from the standpoint of the service had only just begun. The study of materials from the standpoint of the maker, that is, how to manufacture a given product successfully, had made much more progress; but whether that product so manufactured would give the best results in actual service was largely an unknown field. This distinction as to whether a product that can be successfully made from the manufacturing standpoint will give the best results in service, is believed to be a real and a valid one, and one that is far too often overlooked. Finally, the question as to whether there is any room in a railroad organization for an employee or employees, who should devote themselves to the study of materials from the standpoint of the consumer, who should investigate methods and practices, both of construction and operation, that happen to be in daily use, with the view of their improvement, and who should keep in touch with the progress of scientific knowledge, with the view of applying to railroad operation such portions as may be fit, was at that time an entirely unsolved problem. To Mr. Theo. N. Ely, formerly Superintendent of Motive Power, and at present Chief of Motive Power of the Pennsylvania Railroad Company, is due the credit for the conception and the belief that there was room in a railroad organization for an Experimental Department, devoted to the work outlined above, and the securing of a chemist was one of the steps in the development of his idea.

Of the work done by Dr. Dudley during the little over 28 years of his life in Altoona, perhaps that which has attracted the most widespread public attention was the study of steel rails made in the early eighties. The thought which led to and actuated that study throughout was "What does the actual service of the rails in the track teach us in regard to the kind or quality of steel that will give best service?" The plan of the investigation consisted in taking from the track about a hundred rails whose history was known, approximately one-half of which had given inferior service and the other half better service, and subject these rails to both physical test and chemical analysis. Microscopic examination of steel had not at that time come into prominence. The results of the study seemed to point very clearly to the conclusion that mild or softer steel gave not only a safer rail, but also one that suffered less loss of metal by wear, than harder steel. The results were so contrary to the commonly received views on the subject, and were so antagonistic to the interests of the rail manufacturers, since harder steel rails are easier made, that they were received with incredulity. The studies were published in a series of papers in the Proceedings of the American Institute of Mining Engineers, and led to a most animated discussion. They were also published either in full or in copious abstract in various engineering and metallurgical papers in this country and England, and were translated and printed in a number of papers on the continent of Europe. Although the main contention of this study of steel from the standpoint of the user has to this day not been generally accepted, it is perhaps not too much to say that the influence of this investigation on the metallurgical world has been both deep and lasting. By it the steel-maker, as perhaps never before, was given a view of his product from the standpoint of the user, and in no uncertain manner was called upon to study steel, not alone with an eye to output, but also with an eye to the subsequent demands which the service would make upon it. It may not be amiss to add that many metallurgists have expressed appreciation and asknowledgment of their indebtedness to this investigation for new ideas and stimulus in their study of steel.

Another and very important line of work in connection with the laboratory of the Pennsylvania Railroad at Altoona during these 28 years has been the making of specifications for materials. This is perhaps the most exacting and time-consuming work that has been undertaken. No specification has been made without a more or less exhaustive study of the conditions under which the material does its work, and these studies have not infrequently required two or three years or even longer before a specification would be forthcoming. There are now some 43 specifications for different materials in use on the Pennsylvania Railroad, of which part are purely physical, a part purely chemical, and a part jointly chemical and physical. Dr. Dudley can hardly be held responsible for all the specifications, but is responsible for the chemical part, and by way of consultation and suggestion, has helped with the others. The field for the making of specifications is far from being completely worked over as yet, and new ones are continually being made as fast as information can be accumulated. But this making of specifications is only half the problem. The specifications tell what is wanted, but is the material wanted actually furnished? To answer this question involves tests of samples from shipments as they are received, and it is a part of the scheme of the Pensylvania Railroad Company, in connection with its Experimental and Testing Departments, to allow no bill to be paid until the material covered by it has either been inspected by a competent person or been tested either physically or chemically, as the case may be. This scheme, so far as the chemical part is concerned, involves a thoroughly equipped laboratory, with a total force at the present time of eighteen persons, of whom twelve are regularly educated chemists. One of the force is likewise a regularly graduated bacteriologist, who has studied in Europe, and who is occupied in the examination of water supplies, experiments on disinfection, and in making bacteriological tests for diagnosis in connection with the Relief Fund. The total number of tests and chemical determinations made in the laboratory in connection with shipments of materials amounts to about 60,000 per year.

In this connection several years ago, when the number of specifications had reached some thirty or more, it was thought that if the reasons why, for the various requirements were put in print, it might serve some valuable purpose in making the specifications better understood by those desiring to furnish materials. This led to a series of articles, some 25 in number, published in the "American Engineer and Railroad Journal," under the title of "Chemistry Applied to Railroads." Also under the same title, a second series of some 31 articles was published in the same journal, embracing the chemical methods involved in the examination of commercial products bought under specifications. These articles have attracted considerable attention, and although the series was started more than fourteen years ago, it is even now not rare for copies of the various papers to be asked for. It is the intention ultimately to bring the two series up to date and issue them in book form.

As illustrating the influence of an Experimental Department on the constructions and practices actually in daily use on railroads, the studies under the supervision of the Laboratory on the Ventilation of Passenger Cars may be mentioned. These studies embraced a period or some three or four years, and resulted in the development of what is believed to be a very satisfactory system of car ventilation. When the studies were first undertaken the ordinary passenger car either had no ventilation at all, or at the best supplied to the passengers from six to ten thousand cubic feet of fresh air per hour. With the system as devoloped sixty thousand cubic feet per hour are supplied, or one thousand cubic feet per passenger, and this air is warmed to seventy degrees in the most severe weather.

Space does not suffice to describe special investigations or further studies leading to modifications of practices, but it may not be amiss to mention that these investigations and studies embrace such subjects as car lighting, steam heating of cars, studies on disinfectants, resulting in the manufacture of a standard disinfectant by the laboratory studies on cast-iron for car wheels, and for other important uses, studies on paints, studies and long-continued tests on bearing metals, analyses of coals, examination of water supplies, both for boiler and for drinking, and quite an exhaustive study of explosives, resulting in the formulation of rules governing the transportation of these and other hazardous materials.

Dr. Dudley has twice been abroad on business for the company, once in 1886 to study oil burning on locomotives in Russia, and again in 1900, as delegate to the International Railway Congress in Paris. He has been Vice-President of the American Institute of Mining Engineers, and has twice been President of the American Chemical Society. He is at present, as stated above, President of the American Society for Testing Maetrials. He is a member of the English, French and German Chemical Societies, of the Iron and Steel Institute of Great Britain, and of the Verein Deutscher Eisenhuttenleute. He is also a member of the American Society of Civil Engineers, and of the Mining Engineers, the Mechanical Engineers, and the Electrical Engineers as well. He is a member of the Union League Club of Philadelphia, the Cosmos Club of Washington, and of the Engineers' Club of New York.

Apart from his professional work, Dr. Dudley spends no small amount of time in connection with the Altoona Mechanics' Library, in which he is much interested. Under his supervision, and with the fostering aid of the Pennsylvania Railroad Company, this library, which contains now over 35,000 volumes, is accumulating a collection of technical books and bound scientific periodicals which many a more pretentious library might be proud to own.

Dr. Dudley has never married.

Hunter McDonald.

Mr. Hunter McDonald, President of the American Railway Engineering and Maintenance of Way Association, is a Virginian by birth. His great grandfather, Angus McDonald, lived at Glengarry, near Winchester, and by proclamation of Governor Dinwiddie was granted lands for distinguished services against the Indians in 1754. This ancestor also served in Braddock's army in 1755, and in 1774 he commanded an expedition against the Shawnees and Mingos, crossing the Ohio River 120 miles below Pittsburg. This was the advance guard of Lord Dunmore's army. He was com-

missioned by Gen. Washington a Lieut. Colonel in the army of the Revolution.

The military spirit of this ancestor seems to have run in the family, for the next in line, also named Angus McDonald, a grandfather of the subject of this sketch, was a Major in the war of 1812. The father of Hunter McDonald was also named Angus, and he graduated at the West Point Military Academy in 1817 and served two years. In 1819, tiring of garrison duty, he resigned and entered the service of the Missouri Company in the Northwest. He returned to Virginia in 1825, studied law and practiced until the outbreak of the Civil War in 1861. He invented and patented in 1854 an appliance for supplying locomotives with water while running, which differed from the present method only in that the tank was alongside instead of in the middle of the track. Angus W. McDonald married Cornelia Peake, daughter of Dr. Humphrey Peake, of Alexandria, Va. Their son, Hunter McDonald, was born at Winchester, Va., June 12, 1860, being the seventeenth child.

Angus W. McDonald was a Brigadier-General in the Virginia Militia from 1840 to 1860, and at the outbreak of the war his services were at once in requisition. He and six of his sons served in the Confederate Army. The home at Winchester was, of course, in the midst of hostilities, and, in 1864, Mrs. McDonald with the younger children left Winchester and settled at Lexington. Hunter McDonald's earliest recollection is of the bombardment of Lexington by the guns of Gen. Hunter and the burning of the Virginia Military Institute and all the buildings connected with it. After the close of the war the family still remained at Lexington, and Hunter McDonald's youth was passed in constant association with the students of Washington College (now Washington and Lee University) and the cadets of the Virginia Military Institute. Some of his older brothers attended each of these institutions, and he was often a spectator and sometimes a participant in their engineering field practice. He was a pupil in a school taught by his mother until 1871, and he attended the public and private schools in Lexington until the summer of 1873.

Four of the older brothers having settled in Louisville, Ky., it was decided at this time that the mother and the younger children should remove to that city. One of the brothers came from Louisville for the family, bringing with him the necessary funds and tickets. Before leaving he visited the Natural Bridge, taking young Hunter, then a boy of 13, with him. While lying down and looking over the precipice near the famous cedar stump, the pocketbook, containing the tickets and money needed for the emigration, fell out of his pocket and lodged on a ledge about 120 ft. below. The creek beneath was swollen and threatened the book with loss should it be dislodged by throwing stones. After consultation it was decided to lower Hunter with a rope. Accordingly he was seated on a stick tied on the end of the rope and lowered over the precipice. The rope proved too short and the boy was suspended for nearly an hour while more was being secured. After reaching the ledge he crawled along it for some 60 ft. and secured the book.

On reaching Louisville Hunter was placed in the Louisville Rugby School, taught by two of his older brothers, and he graduated in 1878. He then spent one year in the engineering course at Washington and Lee University, and then took a position with the Louisville & Nashville R. R., in charge of a small party making a track survey of that system. Having completed this work on Dec. 1, 1879, he accepted service with the Nashville, Chattanooga & St. Louis Ry., as Assistant Engineer under Col. R. C. Morris, M. Am. Soc. C. E., Chief Engineer, being the only assistant on the system at that time. His service with that railway has been continuous since that time. He has filled various positions in the Maintenance-of-Way and Construction Departments, having had direct charge or responsible supervision of the surveys and construction of all new lines and the reconstruction of those lines acquired by purchase or lease, the mileage having increased from 453 miles in 1880 to 1,196 miles in 1903.

In 1884 Mr. McDonald was in charge of the rebuilding of the Running Water Viaduct.

In 1887-88 he was engineer in charge of the construction of the Huntsville Branch and changing the gage of the Duck River Valley narrow-gage branch. On completion of this work he was appointed Division Superintendent of the Huntsville Division, and at the same time had charge of the surveys and construction of the Tennessee & Coosa extension and the extension of the Sequatchie Valley Branch to Pikeville. In 1891 he was appointed Resident Engineer of the Western & Atlantic R. R., which his company had just leased from the State of Georgia. He was stationed in Atlanta and had charge of the complete reconstruction of the track and bridges and most of the other structures.

On the death of Col. Morris, in November, 1892, Mr. McDonald was appointed Chief Engineer, which position he now holds.

His first work after being made Chief Engineer was the reconstruction of the drawbridge over the Tennessee River at Johnsonville, Tenn., which required the sinking of pneumatic foundations to a depth of 44 ft. below low water. Shortly after its completion he presented a paper to the American Society of Civil Engineers, descriptive of this work.

In 1882 he was elected a Junior, and in 1887 a full Member of the American Society of Civil Engineers. In 1889 he assisted in the organization of the Engineering Association of the South, and became its President in 1895-6. He was the eleventh member enrolled in the American Railway Engineering and Maintenance of Way Association, and was made a Director upon its organization. In 1900 he was employed by the Southern Railway to examine into and report on the cause of the disaster at Camp Creek, south of Atlanta, by which 34 persons lost their lives, due to the washing out of a large arch culvert. His report was made the basis of defense by the attorneys, and the first damage suit resulted in favor of the defendant. The others were compromised. In 1903 he was elected Director for District No. 6 in the American Society of Civil Engineers. He is a member of the National Geographic Society. In 1893 he married Mary Eloise Gordon, of Columbia, Tenn., a great granddaughter of Col. John Gordon, one of General Andrew Jackson's most trusted scouts.

THE WATER SOFTENING PLANT OF THE PROCTER & GAMBLE CO., IVORYDALE, O.

Among the many recent changes and additions to their works at Ivorydale, O., the Procter & Gamble Co. have included the installation of a water softening plant having a capacity of 35,000 gallons per hour. It purifies all the water used for feed purposes in their boiler house, which supplies the steam used in the manufacture of soap and candles, as well as that required in the refining of cotton seed oil and glycerine. In addition, softened water is also supplied to the boilers of the company's electric lighting plant, and also to the locomotives of the Ivorydale & Millcreek Valley R. R.

After having had considerable experience with both the water as it comes from the well and with the same water treated in a device of its own manufacture, the Procter & Gamble Co. entered into a contract for a new plant with the Industrial Water Co. of New York.

The plant installed by the company just named is shown by the view, Fig. 1, and by the plan and sections, Fig. 2. It consists of a lime tank, a reaction tank, and two settling tanks, with a wood fiber filter at the top of each settling tank through which the water passes in its upward flow. In addition, there are two small vats for slaking lime and two similar ones for preparing soda ash solution, all supported on the lime tank.

The untreated water first passes to the overshot wheel, located over the reaction tank, as shown in Fig. 2. After serving its purpose here, by driving agitators in the reaction tank, the water is divided into two parts: The main part goes into the reaction tank and a definite portion flows to the bottom of the lime tank through a central inlet

FIG. 1. VIEW OF WATER SOFTENING PLANT OF THE PROCTER & GAMBLE CO., IVORYDALE, O.

(The two large tanks at the right are not a part of the softening plant.)

pipe. Milk of lime is prepared once in twelve hours in the lime-slaking vats, and admitted to the bottom of the lime tank, where the lime is kept in suspension by the rotating agitator shown in Fig. 2. In its slow upward progress through the milk of lime the untreated water dissolves a sufficiency of calcium hydroxide and becomes saturated lime water. Owing to the absence of agitators in the upper portion of this tank the liquid there is comparatively quiet, and by the time the exit is reached all the heavy particles of milk of lime have been left behind by the lime water, which issues clear and of constant strength. Flowing through the chute it meets the main body of raw water issuing from the gate in the bottom of the wheel box, as well as the proper proportion of soda ash solution which has previously been prepared in the soda vats. The soda solution is fed by means of a valve and connections which are so constructed and automatically operated that the flow of solution is always proportional to the amount of water to be treated. The water and the reagents then pass downward through a pipe into the reaction tank. This tank is of such size as to permit the water to remain in it for a period of one hour, during which time it is thoroughly agitated by means of the stirrer bars on five vertical shafts, actuated from the water wheel by beveled gearing and chain transmission. When the water is ready to pass to, and through the downtakes, into the settling tanks, all the reactions are completed and the precipitate is in such condition that it will settle very readily. The precipitate subsides to the bottom of the settling tanks; the treated water rises slowly and passes through the wood fiber filters, where the very small quantity of matter which is carried in suspension is deposited. The water then flows clear and soft from the outlets to the various boiler houses.

At intervals the precipitates which have settled to the bottom of the settling tanks are disposed of by opening the valves connected with the sludge piping, located at the bottom of the settling tanks.

In washing the filter and disposing of the precipitates, approximately 2% of the total amount of water treated daily is used.

Hoisting apparatus is provided over the lime tank to raise the various reagents from the ground level to the lime and the soda-mixing vats.

The various parts of the plant were designed to have ample capacity to ensure: (1) The use of nothing but clear saturated lime water; (2) complete reaction of the chemicals; (3) thorough settling, with an upward rise of water at so slow a rate that almost none of the precipitate reaches the wood fiber filter; thus rendering it unnecessary to renew the wood fiber except at very long intervals.

From the following table of analyses of the water before and after treatment, made by Froehling & Robertson, of Richmond, Va., the character of the results obtained may be judged:

	Grains per U.S. gall.	
	Raw water.	Treated water.
Silica	0.7523	0.2999
Alumina and iron oxide	.0641	.0641
Calcium carbonate	13.3140	.7990
Calcium sulphate	.1750	.5190
Magnesium sulphate	3.0384	1.2072
Magnesium carbonate	3.1142	.3966
Sodium chloride	1.2772	1.3297
Sodium sulphate	.4141	1.7062
Total	22.1493	6.3217

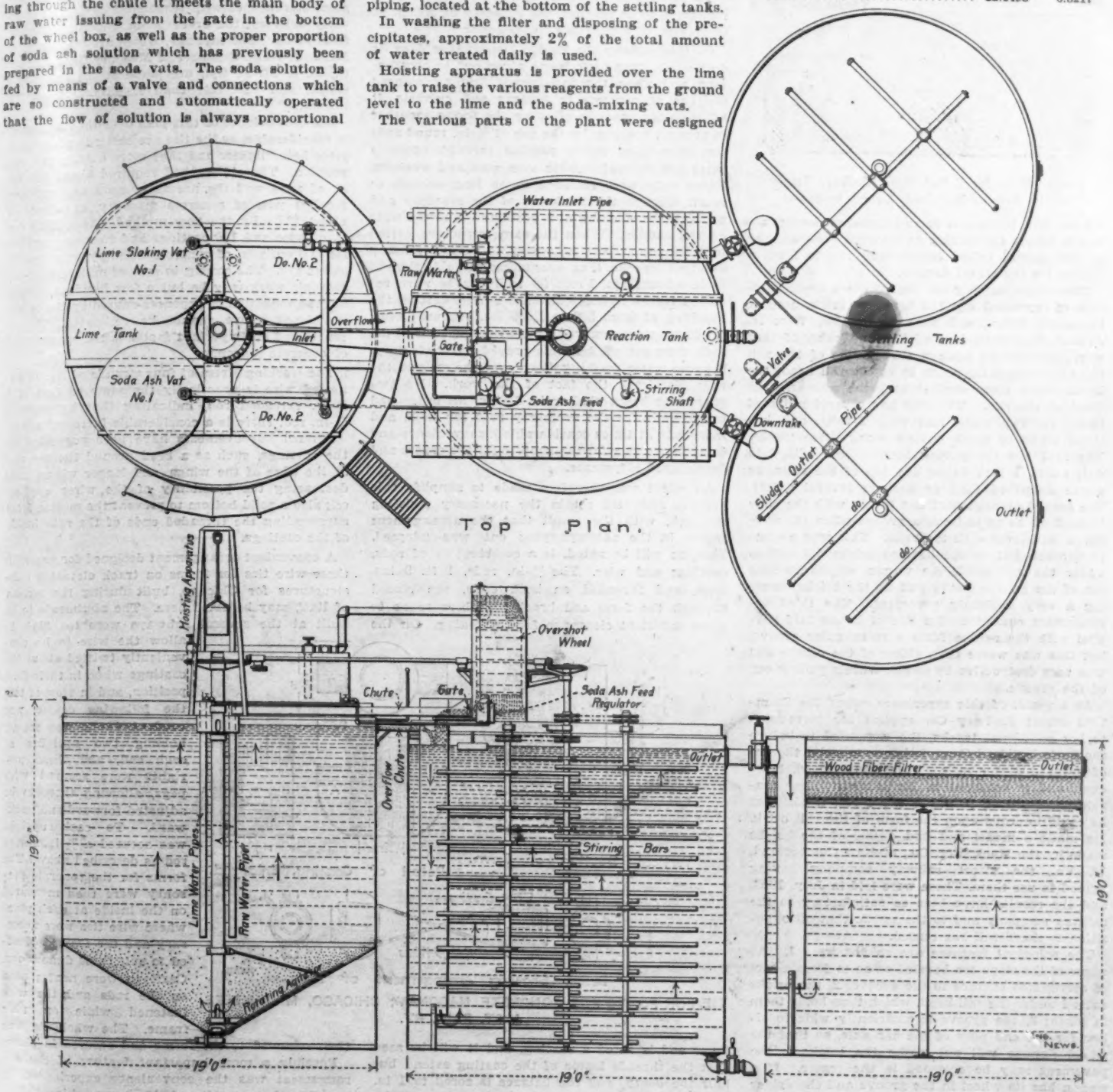


FIG. 2. PLAN AND SECTIONS OF THE WATER SOFTENING PLANT OF THE PROCTER & GAMBLE CO., IVORYDALE, O.

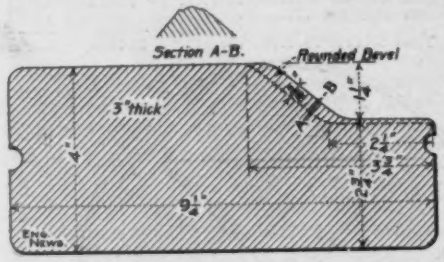
This particular water requires for treatment approximately 4.0 lbs. of fresh lime and 0.5-lb. soda ash per 1,000 gallons. When running at full capacity 2,006 lbs. per day of incrusting calcium and magnesium salts are removed by this plant.

For the information from which this article has been prepared we are indebted to Mr. L. M. Booth, Manager of the Industrial Water Co., 126 Liberty St., New York city.

PAVING BRICK FOR STREET RAILWAY TRACK.

Where T-rails are used for street railway track in brick or asphalt paved streets, the practice sometimes is to lay bricks outside, level with the top of the rail head, and the bricks between the rails level with the bottom of the head, so as to leave room for the wheel flanges.

This is objectionable, however, in that it breaks up the contour of the pavement, and makes it difficult for carriages, bicycles, etc., to cross the



Groove Brick for T-Rail Street Railway Track.
W. H. Arthur, Stamford, Conn., Inventor.

tracks. The better and more general modern practice is to lay the paving to an even contour, and to use special bricks inside each rail to form a groove for the wheel flanges.

The accompanying cut represents a special design of repressed vitrified "groove" brick, used at Stamford, Conn., and patented by Mr. Wm. H. Arthur, Superintendent of Public Works, of that city. The bricks against the outside of the rail have a rectangular notch to fit the rail head, the brick fitting close against both the web and the head of the rail. The city has several miles of street railway track laid with T-rails, and has three kinds of brick paving along these tracks. The first has the paving between the rails laid flat, about 1 inch below the top of the rails, as above described (and as used in several cities). The second arrangement has bricks with the edge beveled off so as to leave a groove when the paving is laid level with the rails. This was an improvement, but as the beveled bricks did not go under the rail head, the wagon wheels turning out of the groove would pull up the bricks, causing a very unsightly pavement. The third arrangement consisted of a line of bricks laid parallel with the rail to form a rectangular groove, but this was worse than either of the others and was very destructive to wagon wheels pulling out of the groove.

As a result of this experience, when the Stamford Street Railway Co. applied for permission to lay additional tracks, the city tried to induce the State Railroad Commissioners to order the use of grooved girder rails. This was refused, however, and it occurred to Mr. Arthur, after considering the good points of the T-rail track, that he could improve upon the form of the rail brick. He made a model and had 40,000 of the bricks made by the Mack Mfg. Co., of New Cumberland, W. Va., the street railway company having agreed to use them. These were laid in July, 1903, and the results have been so satisfactory to the railway company and to the public that all opposition to the T-rail has ceased.

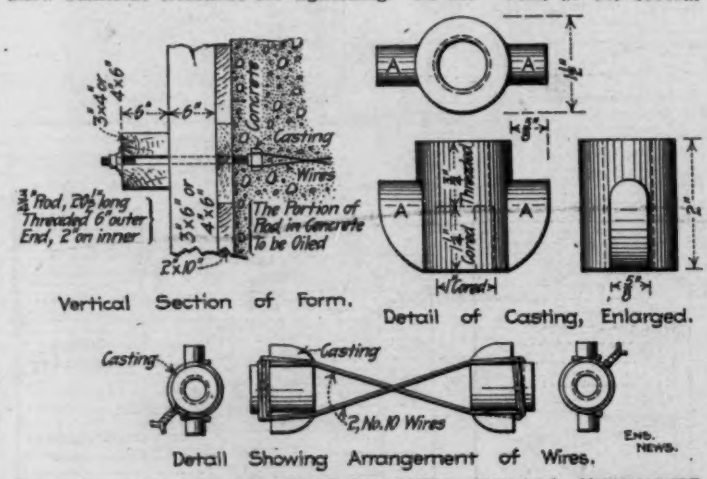
The principal features are as follows: 1. The edges of the slope are beveled so as to form a sort of corrugated surface to the groove; 2, the bricks extend under the rail head, which thus holds them in place; 3, the groove is sufficiently wide to allow for the end play of the car axle, so that the wheel flanges will not strike the brick; 4, the pavement may be crowned in the center. If a wagon has its wheel in the groove and the driver turns out, the wheel will catch on the ridge formed by the beveling of the edge of the slope and turn out immediately. If the driver turns against the rail, when the wheels are in the groove, as the groove is just wide enough to allow the wheel to turn a little and the slope is very easy, the wheels will slide out in a very short distance.

A CONVENIENT TIE FOR CONCRETE FORMS.

In building the forms for concrete masonry it is very generally necessary to hold the sides of the forms together by interior ties, and some kinds of ties for this purpose were described in an article on "The Use of Concrete in Railway Structures" in our issue of Aug. 15, 1901, while another tie used for the forms of concrete bridge abutments on the Ulster & Delaware Ry. was described in our issue of July 10, 1902. The Bridge Department of the Chicago, Milwaukee & St. Paul Ry., of which Mr. C. F. Loweth, M. Am. Soc. C. E., is Engineer and Superintendent, has recently adopted a method of tying the sides of the forms together which is cheap and at the same time efficient. This method is described below from particulars furnished to us through the courtesy of Mr. C. E. C. Harris, of the Bridge Department.

On this railway the Bridge Department does its own work, very little being given out to contractors, and when the department first commenced the use of concrete in bridges and culverts, it adopted the practice of tying the forms together to prevent bulging, by the use of ¾-in. round rods (or later ½-in. rods), passing through opposite posts and secured outside with nuts and washers. These rods were required to be long enough to reach through the thickness of the masonry and through the sheeting and posts and hold the nuts on the outside. When the same structure varied in thickness it was necessary to calculate many different lengths, thus consuming valuable time to little advantage. From 50 to 100 rods were required for an average structure, necessitating the handling of from 500 to 1,000 lbs. of iron. After the forms were removed, the projecting ends of the rods were cut off, but this proved unsatisfactory, because water washing down over the ends of the rods discolored the fact of the work. No two structures being similar in design, an order had to be made for the necessary rods for each, and there was at times considerable inconvenience and delay in waiting for the shop to fill the orders and for delayed shipments.

An effort was therefore made to simplify this system, and still retain the necessary resisting strength, with the result that the arrangement shown in the accompanying cut was adopted. This, as will be noted, is a combination of rods, castings and wire. The ¾-in. rods, 1 ft. 9 ins. long, and threaded on both ends, are placed through the form and bracing timbers so as to allow sufficient clearance for tightening. On the



TIE FOR FORMS FOR CONCRETE MASONRY; CHICAGO, MILWAUKEE & ST. PAUL RY.

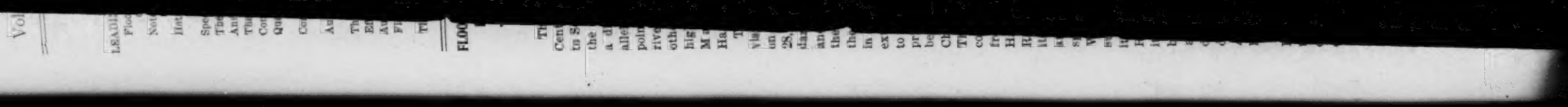
inner end is fitted a casting, and it will be seen that the threads inside of the casting extend but half the depth, and the balance is cored to 1 in. diameter. It may allow mortar to surround the ends of the rods, but this is provided for by oiling or greasing the rods before placing, which makes their removal easy. The castings are simply rough castings, but the rounded surface of the wings (A) is cast or filed smooth so as to leave no sharp projections to cut into the wires when they are tightened. The castings are screwed onto the inside ends of the rods to their final positions, and remain permanently in the concrete.

The wire used is No. 10 annealed fence wire; four strands securely tied, as shown, to the opposite castings and tightened by turning the nut on the outside ends of the rods until about 2 ins. of each rod will project into the concrete. After the concrete has hardened sufficiently, the forms are removed, the rods withdrawn, and the depressions left by them grouted, thus making a clean face, with no exposed metal to cause discoloration. The use of wire also eliminates the necessity for any previous calculations for lengths of ties, and enables a stock of castings, short rods and wire to be kept to anticipate the demand, thus avoiding delays. A request may be made on the department storekeeper with reasonable assurance of an early delivery, the order being filled immediately from stock. The castings, which are the design of Mr. J. C. Hain, Engineer of Masonry Construction, C., M. & St. P. Ry., are made at the company's shops, and cost less than if purchased on the market.

The convenience of this plan over the old method is considerable, as the ties are easier to place, each piece being lighter and thus more quickly put into position. The old method required about 800 lin. ft. of rods, and the necessary nuts and washers, for 500 yds. of concrete masonry, at a cost of about $27. By the new method, about 2,000 lin. ft. of wire and 130 castings and rods are required for 500 cu. yds. of concrete masonry, at a cost of about $15. The saving in cost of material for one season's work may be but a few hundred dollars, but the reduction of expenses caused by the delays mentioned above cannot be estimated. This is considered an important factor in the construction of concrete masonry.

The working stress of four strands of No. 10 annealed wire is practically the same as that of a ½-in. threaded rod, indicating that by using a ¾-in. rod, there is a considerable factor of safety.

Several improvements have been suggested on the castings, such as a bead around the top and at the edge of the wings, and longer wings, thus decreasing the possibility of the wires slipping off; also a solid bottom to prevent the mortar from surrounding the threaded ends of the rods inside of the castings.

A convenient arrangement designed for use with these wire ties for forms on track elevation substructures for Chicago, built during the season of 1902, may be noted here. The abutments to be built at the several subways were too high to allow the wire to be conveniently twisted about the castings when in their final position, and in view of this the following device was used: A frame was set up holding two uprights at each end, and these uprights were secured with pegs, allowing them to be adjusted forward and backward. To each upright was secured a ¾-in. round rod as described above. The forms for the concrete masonry were then measured on the inside at each place where wire ties were necessary and the frame adjusted to suit these dimensions. Castings were next placed on the rods and the wire fastened while on the frame. The whole tie was then removed to the forms and secured in place.

Possibly a more important feature of the arrangement was the convenience experienced in avoiding the necessity of the men working in the cramped interior of the forms while placing the ties. This arrangement may be set up in any convenient position near the structure and at the same time not interfere with the prosecution of the balance of the work. Such a frame can be constructed by any gang carpenter at small expense, and simplifies this feature of construction on large concrete structures. The design can be modified to suit the convenience of existing circumstances.